THE

PHILOSOPHY

OF

EARTHQUAKES,

NATURAL and RELIGIOUS.

OR

An Inquiry into their Cauſe, and their Purpoſe.

O Vitæ philoſophia dux, virtutum indagatrix, expultrixque vitii! Cicero.

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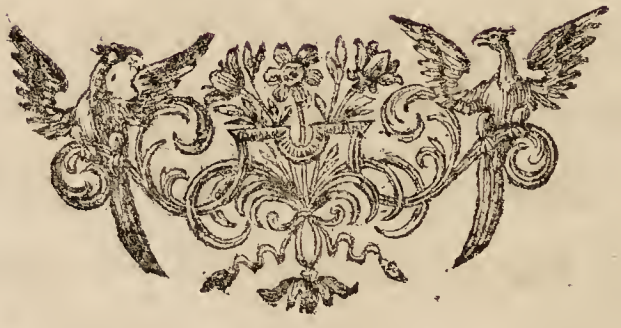
MDCCL.

To the READER.

THE substance of the philosophical part of this discourse was delivered at twice to the Royal Society, on March 15, *and* 22: *The theological, in my own church. I could not refuse the solicitation of my friends, hearers in both places, to print it. I wish my intention, in the compliance, may any ways prove successful; to show, how vain, and unmeaning, are all our philosophical inquiries, when destitute of their true view; to lead us into the more engaging paths of religion. That, from speculation of material causes, we may become adepts in that wisdom which is from above. Otherwise, like* Epicurus, *and the ancient heathen philosophers, we barter away our immortal part, for a curiosity, that amuses us to no good purpose. Mean are these objects of our senses to be accounted, in comparison of our spiritual*

natures, to which our principal regard is due! For we muſt rightly ſay with Job: Lo, theſe are parts of God's ways, but how little a portion is heard of him? and the thunder of his power, who can underſtand?



TO

Martin Folkes, Eſq; LL. D.

Preſident of the Royal Society.

March 26, 1750.

WHEN ſo great and unuſual a *phænomenon*, as an earthquake, and that repeated, happens among us; it will naturally excite a ſerious reflexion in every one that is capable of thinking. And we cannot help conſidering it, both in a philoſophical, and a religious view. Any mind will take the alarm, when we perceive a motion that affects the earth, that bears the whole city of *London*, and ſome miles round it. And at the ſame time while it gives us ſo ſenſible a ſhake, ſo gently ſets us down again; without damage to any buildings, and without a life loſt.

'Tis hard to ſay, which is the greater wonder. But alas in the works of nature, there are no degrees of great, and little; compariſons are incompatible. We indeed are more affected with what ſeems great in our own apprehenſions: I would rather ſay, what is rare and

unuſual. An omnipotent power admits of no diſtinctions. And when prodigious effects are produc'd from cauſes imperceptible, it rightly claims our moſt ſerious attention, as well as wonder. Nor need we loſe ſight of the theological purpoſe of theſe amazing alarms; whilſt we endeavour to find out the philoſophy of them.

Among all the appearances of nature, which are the ſubject of the inquiries of the Royal Society, none more deſerves the regard of a contemplative mind. And among the very numerous accounts received there, from all quarters, being only Obſervations upon the manner of it, and its extent: I judg'd, it became us to inquire into the *cauſe* of ſo extraordinary a motion: of which we could not form a proper idea; had we not repeatedly ſeen, and felt it.

The moderns have not improv'd upon the opinions of the ancients, in this matter; any further than by the fancied analogy of ſome chymical experiments. But theſe chymical experiments, and all ſorts of exploſions by gunpowder, and the like, are to me a very unſatisfactory ſolution; they are merely artificial compoſitions, which can have nothing ſimilar in the bowels of the earth, and they produce their effects by violence, by rending and tearing, by a *ſolutio continui*. This is indeed too often the caſe of earthquakes, but *that* in a partial

partial degree, not at all equivalent to the compaſs of the ſhock; and is very far from being the conſtant concomitant of an earthquake. Quite the contrary. Innumerable ſuch happen, when there is no breach of the ſurface; and of theſe three or four which we have now felt, nothing of it has appear'd. But the immenſity of the vibration of the earth which ſhook every houſe in *London*, with impunity, and for twenty miles round, can never, in my apprehenſion, be owing to ſo unbridled a cauſe, as any ſubterraneous vapours, fermentations, rarefactions, and the like; the vulgar ſolution. Nor does the kind of motion, which I diſcern in an earthquake, in any ſort agree with what we ſhould expect from exploſions.

In order then to proceed with ſome degree of certainty, in our inquiry after the cauſe of earthquakes, it will be uſeful, in the firſt place, to ſet in one view, the general appearances remarkable therein; the moſt uſual concomitants: As we can collect them from our own obſervation, or from the relations and writings of others.

CIRCUMSTANCES.

I. That earthquakes always happen in calm ſeaſons, in warm, dry, ſultry weather; or after a dry, froſty air.

II. That they are felt at ſea, as well as land, even in the main ocean; and at that time, the ſea is calm.

III. That earthquakes differ very much in magnitude. Some ſhake a very large tract of country, at the ſame inſtant of time; nay, ſometime extend to very many countries, ſeparated by mountains, ſeas, lakes, the ocean.

IV. That earthquakes differ very much in the quantity, of their vibratory motion: Whence in ſome, tho' largely extended, they are innocuous; in others, both ſmall and great, they lay all in ruin and deſtruction.

V. That a hollow, thundering, unuſual noiſe accompanies them, or rather ſeems to preceed the ſhock; which rolls in the air like the noiſe of cannon.

VI. That they are felt more ſenſibly in the upper ſtory of houſes than in the lower.

VII. That the ſhock is more violent upon more ſolid buildings, churches, caſtles, and ſtone-houſes, than upon thoſe of ſlighter materials.

VIII. That many people find themſelves ſick at ſtomach, with headake, and pains in their joints, and the like, which ſometime laſts for the day after, or longer.

IX. That earthquakes generally happen to great towns, and cities, and more particularly to thoſe that are ſituate on the ſea.

X. That earthquakes do not cauſe any damage

mage to ſprings and fountains; but the water in wells becomes foul for a ſhort time.

XI. That they are more frequent in the neighbouring countries of a vulcano.

This laſt circumſtance, in my opinion, has led all inquirers in this queſtion, out of the true path; therefore I propoſe in the enſuing paper.

I. To ſhew what it is not; the inſufficiency of the vulgar opinion, of ſubterraneous fires and vapours.

II. To ſhow what it is in reality, as it appears to me.

III. I ſhall conclude with the moral uſe we ought to make of theſe prodigies of nature.

I. The ſtruggles of ſubterraneous winds and fires, that ſhould heave up the ground like animal convulſions, ſeem to me impoſſible: Their powers, and manner of acting (if ſuch there be) is quite incapable of producing the appearance of an earthquake. That theſe ſhould operate inſtantaneouſly, in one minute, thro' a circle of 30 or 40 miles diameter, or more, I could not conceive. Nor that there ſhould be any poſſible, much leſs ready paſſage thro' the ſolid earth, for ſuch nimble agents, as every one is apt to imagine, that ſpeak of this appearance; without ſufficiently reflecting on the inſuperable difficulties in that *hypotheſis*.

We cannot pretend to deny, that there may be ſuch vapours, and fermentations, inflammable

ble ſubſtances, and actual fires, in the bowels of the earth; and that there may be ſome caverns under ground, as well as we find ſome few above ground: ſuch as *Pool's-Hole*, *The Devil's-Arſe in the Peak* of *Derbyſhire*, and *Okey-Hole* in *Somerſetſhire*. Theſe, I believe, to have been ſo from the creation, never were made by earthquakes. We know, there are hot ſprings running continually: There are ſome vulcano's frequently belching out flames and ſmoke, and to theſe perhaps ſome earthquakes may be owing, tho' not according to the vulgar notion; as we ſhall ſee, by and by.

But theſe matters are very rare, much rarer than earthquakes, both as to time and place. *Veſuvius* in *Italy*, and in that part of it abounding with mines of ſulphur: *Ætna* in *Sicily*, and *Heckla* in *Iceland*; theſe are all we know of, in the old world. In the *Andes* mountains of *America* there are ſome. The ſcarcity of theſe appears to me a ſtrong argument againſt the common deductions made therefrom, as to their being the cauſe of earthquakes.

Nor can I enter into the ſentiments of thoſe that hold the cavernous ſtate of the earth, ſo as to contribute to the forming an earthquake by vapours running from place to place under ground. How many thouſand acres of coal-mines do they daily work in *England*, and have done for ages? I have been myſelf 2 or 300 feet deep in a ſolid rock of native ſalt: I have walked a mile lengthwiſe directly into the earth, and

deſcending

deſcending all the way, in the proportion of one yard in five, 'till we came under the bed of the very ocean, where ſhips were ſailing over our heads. This was at Sir *James Lowther*'s coal-pit, at *Whitehaven*. We were at this time deeper under ground by the perpendicular, than any part of the ocean, between *England* and *Ireland*.

We never hear, from the many hundreds of thouſands of workmen in this kind, at *Newcaſtle*, *Nottinghamſhire*, *Yorkſhire*, *Derbyſhire*, *Staffordſhire*, *Somerſetſhire*, and *Wales*: from the infinite numbers of workmen in the mines of lead, tin, and the like, of the cavernous ſtate of the earth, ſo as to give any colour for this *hypotheſis* of earthquakes. The earth is generally of ſolid rock; in which there muſt be now, and then, ſome clefts, and vacuities, ſmall in compaſs, as naturally ſo many heterogeneous *ſtrata* of the earth conſolidate together. But there can be no imagination of vapours breaking through, uniting, traverſing ſo ſuddenly, a large ſpace of earth, ſo as to produce thoſe earthquakes, we have ſeen, and felt; much leſs ſuch as we read of. The workmen in all ſorts of mines confeſs by their hard labour, that the earth is not cavernous; nor are there mines of ſulphur, nitre, and the like inflammable materials in *England*. Or if there were, could they burn, and cauſe convulſions of the earth, without proper cavities, pipes, and conveyances of air;

air ; as vulcano's, and coal-pits, when ſet on fire. But even from theſe coal-pits, when fired, do we ever find any thing like an earthquake produced. Nor do we find earthquakes frequent in thoſe countries, that abound with coal-mines, as certainly would be the caſe, if that *hypotheſis* was juſt. How eaſy would it be, on the ſlighteſt occaſion for earthquakes to happen in the countries abounding with coal-mines, which are ſo full of artificial cavities communicating with one another, for many miles together: The very thing ſuppoſed, by thoſe who hold the old opinion, of vapours traverſing the earth for that purpoſe.

In the coal-pits, ſome ſmall natural cavities now and then are found ; which when opened, ſend forth a peſtiferous vapour, and a fire-damp which runs for a long time together. And tho' there are many ſubſtances that may generate air, within the bowels of the earth ; yet theſe matters are infinitely unable to produce an earthquake : Never would have force to open a paſſage for themſelves thro' the ſolid rock, of perhaps many hundred feet in thickneſs. Nor did we obſerve in theſe laſt earthquakes any fire, vapour, ſmoke, or ſmell, any kind of eruption, in the leaſt ; as muſt certainly have been, in ſo great a ſtruggle of the ſuperfice, as affected a circle of ſo large a diameter. Were there ſuch, we could ſcarce hope any otherwiſe, than that they would be

too

too ſenſibly felt; to the deſtruction of many thouſands, by their peſtiferous qualities.

Indeed this conſideration alone, of the extent of that ſurface, is ſufficient to overthrow any ſuppoſition, of earthquakes being chiefly owing to ſubterraneous vapours: They cannot momentarily fly under ſo large a tract of ground, if they were near the outward ſhell of the earth. They could not do it without breaking ground, and diſcovering themſelves to the ſight, or ſmell; and that for a long time after. It cannot poſſibly be imagin'd, they ſhould have ſo immenſe a force, as to lift up the city of *London*, and never be perceived by our organs, and outward ſenſes. We have frequent accounts of a little fire-ball burſting in the air, at a diſtance; yet it inſtantly propagates a ſulphureous ſmell around.

If the movement of a ſuperficies of 30 miles diameter was owing to fumes, and vapours; we ought reaſonably to find ſome great diſcharges of them, belching out ſmoke and fire, for a long time after, like vulcano's, and coal-pits fir'd. The operation of the ſhock ought to be of hours continuance, not inſtantaneous; and the evaparation of ſo vaſt a quantity of matter, muſt darken the whole region of the air for a long time after; or require a long time, if gradually it diſcharges itſelf. We ſee how immenſe a volume of ſmoke is produc'd

by

by a very ſmall quantity of gun-powder; and no vapour could be ſo ſubtle, that produc'd ſuch effects, and not be very obvious to our ſenſes.

Even in vulcano's, it is the opinion of the learned *Italian* philoſopher *Borelli*, and of other great naturaliſts, that they are kindled firſt from the ſurface, where there is a poſſibility of ventilation from the air. They imagine, it begins at the top of the mountains; not by any fancied fermentation of the *pyrites* and ſulphureous vapours ariſing from ſubterraneous caverns, in the lower parts of mountains.

There is another conſideration, which utterly overthrows theſe ſuppoſitions, of earthquakes being cauſed by any thing under-ground; and that is a due conſideration of ſprings, and fountains perpetually flowing; and that from the creation of the world to this day. If we would form any tolerable idea of their nature, we muſt needs conceive, that God Almighty has laid their pipes, and canals in the earth, from a great depth, even to the ſurface; like as he has planted the veins, arteries, and glands in an animal body. And likewiſe that they are more and more ramify'd, as they nearer approach the outward ſhell of the earth; juſt ſo our veins, and arteries, as they come nearer the skin.

The workmen in coal-mines, and thoſe of metals, minerals, and ſtone-quarries, never fail

to

to meet with ſprings, and currents of water, every where. Often they ruin, and divert ſprings another way, only by digging into the earth for foxes, and the like. Whenever they dig for wells, in any kind of earth, they commonly find ſprings. The colliers, and workers of mines, are oblig'd to drain the waters off with very great expence.

Theſe are circumſtances not favorable to ſubterraneous fires being in the earth in abundance; much leſs to their being the cauſe of earthquakes. And further, we cannot poſſibly think of earthquakes doing their work that way, without abſolutely ruining the whole ſyſtem of ſprings, and fountains, throughout the whole country, where they paſs. But all this is quite contrary to fact; even where an earthquake has been repeatedly. For an inſtance from home.

On *Wedneſday*, *April* 6, 1580, about ſix in the evening, juſt ſuch another earthquake was felt in *London* and around it, as theſe two we have ſeen. Another exactly ſimilar 1692. In all theſe four, no houſes thrown down, no ſprings diſturb'd thereby, no ſenſible eruptions nor ſmells.

Theſe conſiderations I apply only to this little inconſiderable ſpace, of a circle 30 miles diameter; as with us. But what is that to the earthquakes we read of in hiſtory? In the

the year of our Lord 17, no leſs than thirteen great and noble cities in *Aſia minor*, were deſtroyed in one night. *Tacitus*, *Pliny*, and many other authors mention it. The fact is ſo notorious, that ſome perſons here preſent, have ſeen a vaſt block of white marble now ſtanding near *Naples*; being the pedeſtal of a coloſs ſtatue of *Tiberius* the emperor; having carv'd on it the *genius's*, or pictures of all thoſe cities, with their names. The accurate *Buliſon* and others have wrote treatiſes upon it. Theſe cities were rebuilt by that emperor. But without going ſo far, we may ſee another evidence of it, a coin of that emperor ſtruck upon the occaſion, with this inſcription,

CIVITATIBUS ASIAE RESTITUTIS.

I have one of them, in large braſs, which was found at *Colcheſter*.

The compaſs of this earthquake may be reckon'd to take up 300 miles diameter, as a circle. Now, we cannot conceive, how any ſubterraneous vapour can produce ſuch an effect, as inſtantaneouſly to demoliſh all theſe cities; and that ſuch an accident ſhould never happen after. That the whole country of *Aſia minor* ſhould not at the ſame time be deſtroy'd, its mountains be renverſed, its fountains, ſprings, and rivers broken up and ruin'd for ever. Inſtead whereof we find nothing

thing ſuffered, but thoſe cities; no kind of alteration in the ſurface of the country; it remains the ſame as it were in the beginning of time. In 1586 an earthquake in *Peru*, that extended 900 miles.

From theſe conſiderations, I cannot perſuade myſelf, to enter into the opinion of vapours, and eruptions being the cauſe ſought for; and, after we have treated the argument in a ſuperficial view, we muſt go a little deeper.

If we would conſider things like philoſophers, let us propoſe to ourſelves this problem: Where is the power to be plac'd, that is requir'd to move a ſurface of earth 30 miles in diameter?

To anſwer this, conſult the ingineers, and thoſe that make mines in the ſieges of towns; they will acquaint us, that the effect of mines is produced in form of an inverted cone. And that a diameter of 30 miles, in the baſe, will require an *axis* of 15 or 20 miles to operate upon that baſe, ſo as to ſhake it, at leaſt. Now the vapours, or whatever power we propoſe to operate, according to the foregoing requiſite, in order to form the appearance of an earthquake, muſt be 15 or 20 miles deep in the earth. But what mind can conceive, that any natural power is able to move an inverted cone of ſolid earth, whoſe baſe is 30 miles diameter, whoſe axis 20? or was

it poſſible; would not the whole texture of that body of earth be quite diſturb'd and ſhatter'd, eſpecially in regard to its ſprings and fountains? but nothing like this is ever found to be the conſequence of an earthquake, tho' fatal to cities.

Apply this reaſoning to the earthquake of *Aſia minor*, and this vigorous principle at the *apex* of the cone muſt lie, at leaſt, 200 Miles deep in the ground. Enough to ſhow the abſurdity of any moving power plac'd under the Earth! A cone of 300 miles diameter at baſe, 200 miles *axis*: I dare be bold to ſay, that all the gun-powder made ſince its invention, if put together and fired, would not be able to move it; how much leſs pent up vapours? what muſt we ſay of a circle of 900 miles diameter?

But, could that be admitted as poſſible, would any one be perſuaded, that ſuch a ſubterraneous tumult, of ſo vaſt an extent, will be no ways injurious to the internal ſyſtem of ſprings and fountains, and that this ſhall often be repeated without the leaſt damage? We may as well imagine, that we can ſtab a man 100 times and never touch vein or artery.

Since I gave in my two papers to the Royal Society, a letter of Mr. *Flamſted*'s has been printed, which abundantly confirms my ſentiments. The whole drift of it is, to ſhow how invalid is the vulgar idea conceiv'd, of earth-

earthquakes ariſing from ſubterraneous vapours and eruptions: That the earth itſelf is not moved to any depth, and that the ſhock muſt ariſe from the atmoſphere. The circumſtances which he has judiciouſly collected, are extremely agreeable to mine; many of them the very ſame, ſtrongly confirming my *hypotheſis*: And had that great man known the properties of electricity, which we are now maſters of, he would have prevented me in this affair.

" Conſidering (ſays he) what variety of " ſubſtances, ſand, gravel, ſtones, rock, mi- " nerals, clay, and mold, our earth is com- " pounded of, and how little nitre, or ex- " ploſive matter, a large quantity thereof will " afford; I cannot think, where we can " find matter enough to move ſo vaſt a bulk " of earth, as all the South parts of *Eng-* " *land*, all the *Netherlands*, with part of " *Germany*, all *France*, and perhaps *Italy*, " (which were ſhock'd at once the 8th of " *September* laſt 1692;) or part of *Aſia*, and " near all *Europe*, which trembled together " the ſame day, 91 years before.

" But, allowing there may have been ſuf- " ficient matter prepared for theſe purpoſes, " I can hardly think, there are continued ca- " vities, at any reaſonable depth, all under " *Europe*, wherein an exploſion being made, " might ſhake the whole at once, and yet

" make no clefts, or ſeparations, in thoſe " parts where the minerals and mountainous " rocks part from the light mold and clay. " If an hundred barrels of gun-powder could " be fixed in ſome cave, a thouſand yards " under ground; allowing the force of the " exploſion ſufficient to raiſe all the weight " of earth incumbent on the cavern; it " would certainly break the looſe mold " from any large ſolid rock we may conceive " adjacent, and leave at leaſt ſome clefts be- " hind it. But we ſeldom or never hear of " ſuch clefts, made in ſuch places, when " earthquakes happen."

Again, he writes thus: " I cannot appre- " hend, (if all earthquakes muſt be made by " exploſions in ſubterraneous caverns) why " ſometimes a large country, or whole con- " tinent, ſhould be thereby ſhook all at once; " why there ſhould be no eruptions in the " neighbourhood?"

From all circumſtances conſider'd, he concludes, that the abſtruſe, effective cauſe of them comes from the air; and that a calm is neceſſary before an earthquake. And theſe two particulars are likewiſe Dr. *Hales*'s poſitions: " The earth-lightning, as he calls it, " is firſt kindled on the ſurface, and not at " great depths, as has been thought; whoſe " exploſion is the immediate cauſe of an " earthquake. He ſays, long, dry, hot ſea- " ſons,

" ſons, are uſually the preparatory forerun-
" ners of earthquakes." From all theſe con-ſiderations I conclude; earthquakes are not caus'd by ſubterraneous vapors.

II. We are to inquire, what is the cauſe of earthquakes.

In an age when electricity has been ſo much our entertainment, and our amaze-ment; when we are become ſo well acquaint-ed with its ſtupendous powers and proper-ties, its velocity, and inſtantaneous operation through any given diſtance; when we ſee, upon a touch, or an approach, between a non-electric and an electrified body, what a wonderful vibration is produc'd! what a ſnap it gives! how an innocuous flame breaks forth! how violent a ſhock! Is it to be won-der'd at, that hither we turn our thoughts, for the ſolution of the prodigious appearance of an earthquake?

Here is at once an aſſemblage of all thoſe properties and circumſtances which we ſo often ſee in courſes of electricity. Electrici-ty may be call'd a ſort of ſoul to matter, thought to be an ethereal fire pervading all things; and acting inſtantaneouſly, where, and as far as it is excited. 'Tis every body's obſervation, that there never was a winter, like the laſt paſt, in any one's memory, ſo extremely remarkable for warmth and dri-neſs, abounding with thunder and lightning,

very uncommon in winter; coruſcations in the air frequent, juſtly thought electrical by all philoſophers; particularly, twice we had the extraordinary appearance of that called *aurora auſtralis*, with colours altogether unuſual; and this juſt before the firſt earthquake: All the while the wind conſtantly ſouth and ſouth-weſt, and that without rain, which is unuſual with theſe winds.

This ſtate of the atmoſphere had continued five months before the firſt earthquake. Is it not hence reaſonable to conclude, that the earth, eſpecially in our region, muſt be brought into an unuſual ſtate of electricity; into that vibratory condition wherein electricity conſiſts; and, conſequently, nothing was wanting but the approach of a non-electric body, to produce that ſnap, and that ſhock, which we call an earthquake; a vibration of the ſuperficies of the earth.

That the earth was in that vibratory and electric ſtate we have further reaſon to conclude, from the very extraordinary forwardneſs of all the vegetable world with us. Every one knows, that, at the end of *February*, all ſorts of garden-ſtuff, trees, fruits, and flowers, were as forward as in other years, by the middle of *April*. Conformable to which, experiments abundantly ſhow, that electrifying of plants quickens their growth, equally as in animals it quickens the pulſe.

Nor

Nor will the unuſual drineſs and warmth of the weather ſolely account for ſuch a precipitate vegetation: becauſe a neceſſary ſupply of rain was wanting, as in the natural Spring-ſeaſon.

A very long dry froſt will produce the ſame electrical ſtate of the earth, as it equally favours electrical experiments. Thus, *March* 27, 1076, a froſt from the 1ſt of *November* to the middle of *April*, a general earthquake in *England* ſucceeded. *Matt. Paris.* That of *Oxford*, 17th of *September* 1683, was after a froſt. *Jan.* 4, 1680, An earthquake in *Somerſetſhire*: The air was very calm; a froſty night.

Mr. *Flamſted* concurs with us, in our firſt poſition, That earthquakes always happen in *calm* ſeaſons. He adds, "That *Keckerman*, "a learned author, who wrote on the ſub-"ject, affirms, and backs it from the au-"thority of *Ariſtotle* and *Pliny*."

The 8th of *September* 1601 was a very calm day but cloudy: And the *Smyrna* merchants obſerve the earthquakes there happen in calm, ſtill weather. The remarkable clearneſs and calmneſs of the morning was obſerved in that of *Oxford* 17th of *September* 1683, and the air continued ſo for five or ſix days after: Therefore we may infer, that it is not impoſſible, what has been abundantly related, that ſome foreigners from *Italy* here

in *England*, ſome from the *Weſt-Indies* (in both which countries earthquakes are more frequent than with us) did ſeem to apprehend our firſt earthquake, from the apparent temper of the weather; and obſervations of this kind are as old as *Ariſtotle*. It is obſerved in *Jamaica*, when the air is extraordinary calm, an earthquake is always apprehended.

We had lately read at the Royal Society, a very curious diſcourſe, from Mr. *Franklin* of *Philadelphia*, concerning thunderguſts, lightning, the northern lights, and like meteors. All which he rightly ſolves from the doctrine of electricity. For, if a cloud raiſed from the ſea, which is a non-electric, happens to touch a cloud raiſed from exhalations of the land, when electrified, it muſt immediately cauſe thunder and lightning. The electrical fire flowing from the touch of perhaps a thouſand miles compaſs of clouds, makes that appearance which we call lightning. The ſnap which we hear in our electrical experiments, when re-echoed from cloud to cloud, the extent of the firmament, makes that affrightning ſound of thunder.

From the ſame principle I infer, that, if a non-electric cloud diſcharges its contents upon any part of the earth, when in a high electrified ſtate, an earthquake muſt neceſſarily enſue. The ſnap made upon the contact of many miles compaſs of ſolid earth, is that horrible

horrible uncouth noiſe, which we hear upon an earthquake; and the ſhock is the earthquake itſelf.

In the relation received from *Portſmouth*, and the *Iſle of Wight*, concerning the laſt ſhock there, on the 18th of *March*, the writer obſerves, the Day was warm and ſerene; but, upon a gentle ſhower falling in the evening, the earthquake came. Here we have reaſon to apprehend the electrified ſtate of the earth, and the touch of the non-electric: which cauſed the earthquake.

The learned Dr. *Childrey* obſerves, treating on this ſubject, that earthquakes happen upon rain; a ſudden ſhower of rain in the time of a great drought.

'Tis objected, that, if this was the caſe, nothing would be more frequent than earthquakes; but theſe two circumſtances concurring, a ſhower and dry weather, muſt not neceſſarily cauſe it, any more than touching a tube before it is electrified cauſes a ſnap. The earth muſt be in a proper electrified ſtate to produce it; and electricity has its fits; is remitted, intended, ceaſed and recommenced. It has its bounds. All cauſes muſt concur. And now, with us, all neceſſary cauſes did ſo apparently. Tho' a ſhower of rain falling upon the earth when electrified, may cauſe an earthquake, yet too much rain before, will prevent that ſtate of electricity, neceſſary.

The

The day before the cataſtrophe of *Port-Royal*, the weather was remarkably ſerene and clear. In that moſt dreadful earthquake, 1692, of *Sicily*, where 54 cities and towns, beſide a great number of villages were deſtroy'd; but eſpecially the whole city of *Catania*: It was preceded by a moſt agreeable, ſerene and warm ſeaſon, which was the more obſervable on account of its being unuſual at that time of the year.

I have been inform'd, that in the morning of both earthquakes laſt paſt with us, the air was ſerene and calm; on the morning before that 8th of *February*, the air was obſerv'd to be remarkably calm; and that a little before, a black cloud appear'd over great part of the horizon. Dr. *Hales*, in his relation, ſays, the Centinels in *St. James's Park*, and others who were abroad in the morning of the laſt earthquake, obſerv'd a large black cloud, and ſome coruſcations, juſt before the ſhock, and that it was very calm weather: And that, in the hiſtory of earthquakes, they generally begin in calm weather, with a black cloud.

This obſervation precludes the ſuſpicion of earthquakes ariſing from tumults and commotions in the upper, or under region of the air. The remarkable clearneſs of the air before earthquakes, obſerv'd by all, ſhows evidently how free it is from vapours and the like.

Agree-

Agreeable to our *fifth* poſition, Mr. *Flamſted* writes, "A hollow noiſe in the air al-
"ways precedes an earthquake, ſo near that
"it rather ſeems to accompany them. He
"refers us to *Philoſophical Tranſactions*, N°
"151. *p.* 311. The noiſe was heard by
"many that liv'd in the out-ſtreets, and al-
"leys of *London*, remote from the noiſe and
"tumult of the greater ſtreets."

This he ſpeaks of that felt in *London* 1692; but now the whole city heard the noiſe, on both theſe earthquakes of ours.

The gardener, who gave a relation to the Royal Society of what he obſerved in the *Temple*-garden, took notice, that firſt he heard the moſt dreadful noiſe imaginable, which he thought to be a great diſcharge of ſhip-guns, on the river: and that the noiſe rolled from the water-ſide towards *Temple-bar*, rather before the nodding of the houſes.

The gentleman who obſerved it about *Hartingfordbury*, ſays, the noiſe preceded the ſhock. And this is a common obſervation, which at once both ſtrengthens our opinion of electricity, and confutes that of ſubterraneous vapours; for, in the latter caſe, the concuſſion muſt precede the noiſe.

Agreeable to our *ſecond* poſition, Mr. *Flamſted* writes, "That earthquakes are felt at
"ſea, equally as on land. Our merchants
"ſay, that, tho' the water in the bay of
"*Smyrna*

" *Smyrna* lies level, and ſmooth as a pond; " yet ſhips riding there feel the ſhocks very " ſenſibly, but in a very different manner " from the houſes at land: For they heave " not, but tremble; their maſts ſhiver, as if " they would fall to pieces, and their guns " ſtart in their carriages, tho' the ſurface of " the ſea lie all the time calm and unmov'd."

In Dr. *Hook*'s *Philoſophical Collections*, N° 6. *p.* 185, we are told, " That a ſhip felt a " ſhock in the main ocean; that the paſſen- " gers, who had been aſleep in their cabins, " came upon deck in a fright, fearing the " ſhip had ſtruck upon ſome rock; but, on " heaving the lead, found themſelves out of " ſoundings."

All this is extremely agreeable to our aſſumption. The water receives the electrical touch, and vibratory inteſtine motion of its parts, as well as land. And the impreſſion may be made ſolely on the water a non-electric, by the touch of an electric fire-ball, or the like; and that ſeems to have been often the caſe. The proper vibratory motion is impreſs'd on the water without ruffling its ſurface; and ſo communicated to all the parts of the ſhip, gives the ſenſe of a ſhock to the bottom, the ſhivering to the maſt, and the reſt of the ſymptoms: which ſufficiently proclaim the cauſe of it to be an electrical impreſſion upon the water. The preſident mentioned

tioned a relation of a waterman, that felt it in his boat upon the river; he thought it like a great thump at the bottom of the boat. And ſo the ſhips at ſea fancy, they ſtrike upon a rock.

This makes us apprehend, the reaſon of the fiſhes leaping up out of the canal in *Southwark*, of which we had an account. So in that of *Oxford*, 1683, one fiſhing in the *Charwell* felt his boat tremble under him, and the leſſer fiſhes ſeem'd affrighted by an unuſual skipping. That electricity is the cauſe ſought for, ſeems deducible from this conſideration. Several writers on earthquakes aſſimilate theſe vibrations of the earth to thoſe of a muſical ſtring. Experiments have ſhown, that fiſhes in water may be killed by the particular tone of a muſical ſtring; and 'tis known, that electricity will kill animals. They aſſuredly felt the vibratory motion in the water, which they were abſolutely ſtrangers to before. No doubt it made them ſick; as thoſe of weak nerves on land. And this circumſtance alone precludes any ſuſpicion of ſubterraneous fires under the ocean. Or, if we were to admit of it, would the boiling of the water exhibit any appearance, like what we are ſpeaking of, either to the water, or to the ſhip?

Mr. *Flamſted* likewiſe concurs in our *eighth* poſition, "That many people found themſelves

" ſelves ſuddenly ſick at ſtomach, and their " heads dizzy and light; ſo that thoſe that had " formerly fits of apoplexies, dreaded their " return; particularly, one gentleman, a ſur- " geon, feeling himſelf ſo affected, and fear- " ing a return of his apoplexy, reſolved to " be let blood, without ſuſpecting the earth- " quake."

After theſe two ſhocks which we felt, many people had pains in their joints and back, as after electrifying; many had ſickneſs, head-akes, hyſteric and nervous diſorders, and colicks, for the whole day after, and ſome much longer, eſpecially people of weak nerves, weak conſtitutions; ſome women miſcarry'd upon it; to ſome it has prov'd fatal.

To this we muſt attribute, that relation we had, of the dog lying aſleep before the fire; but upon the earthquake, he ſuddenly roſe up, run about the room, whining, and endeavouring to get out.

Any ſolid matter is capable of being put into a ſtate of electricity, ſuch as iron guns; and the more ſo, by reaſon of their ſolidity. And in proportion to it, is the greatneſs of the ſnap, and of the ſhock; and a kind of lambent flame iſſues from the point of contact; and likewiſe ſomewhat of a ſulphurous ſmell: So that if both flame and ſmell were

diſ-

diſcernible in an earthquake; 'tis to be found, without going to the bowels of the earth.

Dr. *Hales* mentions, that ſolid bodies are the beſt conductors of aereal lightning; whence oaks are rent, and iron melted. And in our earthquakes in *London*, the loudeſt noiſe was heard near ſuch large ſtone buildings, as churches, with lofty ſteeples. From the top of theſe we muſt apprehend, that the electrical exploſion goes off into the open air; as in our experiments, from the point of ſwords, and the like.

The electrical ſhock is proportionate to the ſolid electrified, agreeable to our *ſeventh* poſition. This fully accounts for earthquakes in general, and for many in particular. What can be imagin'd greater than a ſhock of the body of the earth? 'Tis greater, or leſs in proportion to the ſtate of electrification. And now we can account for ſeveral appearances. In the firſt earthquake, the Lord Chancellor, Maſters in Chancery, and ſeveral Judges, were ſitting in *Weſtminſter-Hall*, with their backs to the wall of the upper-end, which is of a vaſt thickneſs. They all relate the ſeverity of the ſhock, from the wall ſeeming to puſh towards them with great violence.

And thus in the earthquake of 1692, *Deal* caſtle is one of them built by *Henry* VIII. the walls are of immenſe thickneſs, and ſtrength; yet they ſhook ſo ſenſibly, that the people

people living in it, expected it was falling on their heads. And this is the caſe in all earthquakes: the more ſubſtantial the building, the more violent is the ſhock: exactly the mode of electrical vibration. And this Dr. *Hales* takes notice of and others; that an earthquake ſhatters rocks of marble, more eaſily than the *ſtrata* of ſand, earth, or gravel. In the earthquake here of 1692, a great cliff fell down near *Dover*; and part of *Saltwood*-caſtle wall.

'Tis from hence we account for that obſervation, that when we electrify any perſon; upon a touch, the pain and blow of the ſhock is felt at the joints, the wriſt, elbow, and ſhoulder, for inſtance, more than in the intermediate parts; becauſe *there* is the greateſt quantity of ſolid.

At the ſame time, that the force of electricity in ſolids, is as the quantity of matter: we ſee moſt evidently, by innumerable experiments, that water is equally aſſiſtant in ſtrengthning, and conveying the force of electricity; and *that* in proportion too to its quantity. And hence is to be deduc'd the reaſon of my obſervation; that the moſt frequent and dreadful earthquakes have fallen upon maritime places. And I find the ſame is taken notice of in ſome degree, by *Acoſta*, by *Dolittle*, who wrote on that in 1692, and others.

In

In the dreadful cataſtrophe at *Port-Royal* then, 'tis notorious, that its violence was chiefly near the ſea. So *Lima* could not ſuffer without its port of *Callao*. Even in thoſe ſo lately felt by us, they were ſenſibly more violent towards the river, than farther from it.

In that earthquake which was felt in *England*, in the year 1692, (which was very much like theſe with us) there were no houſes thrown down, nor perſons kill'd: but it reach'd more particularly *Sheerneſs*, *Sandwich*, *Deal*, *Dover*, *Portſmouth*, and the maritime parts of *Holland*, *Flanders*, and *Normandy*.

In this that happened on *Sunday* the 18th of *March* laſt, at *Bath*; it was felt particularly and ſtrongly at *Portſmouth*, ſeven miles above and below it, on the ſea-ſide; all round the iſle of *Wight*, at *Southampton*, the ſea-coaſt of *Selſey*, ſouth of *Chicheſter*, *Arundel*, and the whole coaſt of *Suſſex*, without going up the land; and acroſs the ſea to the iſlands of *Jerſey* and *Guernſey*.

On *Monday* night, the 2d of this inſtant *April*, 1750, at ten o'clock, at *Leverpool*, a ſhock of an earthquake. And felt in ſeveral other places in the neighbourhood; but particularly at *Cheſter*, and *Warington*.

If we look into ancient hiſtory, we find 197 years before Chriſt, an earthquake ſhook

terribly the iſle of *Rhodes*, damag'd many cities: and ſome quite ſwallow'd up.

Seventeen years before Chriſt, many cities in the iſle of *Cyprus* deſtroy'd.

Six years before Chriſt, the iſle of *Coos* vehemently afflicted.

During the *Peloponneſian* war among the *Greeks*, the iſle of *Delos* ſhaken, and the moſt beautiful temple of *Apollo* thrown down.

Soon after, the city of *Lacedæmon* totally deſtroy'd.

A. D. 79. Three cities in *Cyprus* overthrown.

A. D. 82. The city of *Smyrna* ruined.

In the time of *Valens* the emperor, a terrible earthquake in *Crete*, whereby 100 cities were deſtroy'd.

Feb. 13, 1247, An earthquake, chiefly felt in the *Thames*. *Matt. Paris.*

May, 1382, A general earthquake, which did much miſchief; the *Friday* following one leſs; the *Saturday* following, one felt moſtly by water. *Henry de Knyhton. Holinſhed.*

A. D. 1456, In the city of *Naples*, 40,000 people loſt.

Conſtantinople has often ſuffer'd; particularly in 1509, 13,000 people overwhelm'd.

1531, At *Lisbon*, 1400 houſes thrown down; as many ſhatter'd.

April,

April, 1690, The *Leeward-Iſlands*, *Montſerat*, *Nevis*, and *Antigua*: At *Martinico*, and the *French* iſlands, at St. *Lucia*, &c. a violent earthquake.

Dec. 8, 1703, An earthquake at *Hull*, a perfect calm.

1702, At *Stroution*, in *Argyleſhire*, which extended all along the weſt coaſt of *Great-Britain*; but to no breadth on land.

Oct. 25, 1734, At *Havant*, in *Suſſex*, conſiderable, the air perfectly calm.

But inſtances enough, to ſhow what I aim'd at, that maritime places are moſt ſubject; which is a ſtrong argument in favour of electricity; when both the ſolid of the earth, and the quantity of the water concur, to make the ſhock; exactly as in electrical experiments; when the bottle of water is held in the hand.

Thus when our mind is diſcharged of the prejudices of former notions, we diſcern, that every appearance favours the principle we go upon. That, agreeable to Mr. *Flamſted*, ſubterraneous exploſions, could they pervade, and traverſe the earth at pleaſure, muſt at laſt burſt, and diſperſe every thing in their way. Yet 'tis not poſſible for us to imagine, ſuch a kind of vibration ſhould follow, either by ſea or land, as that we are treating of. But electricity compleatly anſwers it. This ac-

counts for that ſuperficial movement of the earth, that univerſal inſtantaneous ſhock, which made every houſe in *London* to tremble, none to fall: That quivering, tremulous, horizontal vibration, highly different from any motion we muſt conceive, to be produc'd from ſubterraneous evaporations. Hence authors tell us, *Dec.* 30, 1739, deſcribing an earthquake in the weſt-riding of *Yorkſhire*: It ſeem'd as if the earth mov'd backward and forward horizontally; a quivering, with reciprocal vibrations.

Mr. *Flamſted* rightly accounts the motion of earthquakes to be undulatory; and by being continued, cauſes a like motion to a great diſtance. As when you ſtrike a long ſtretch'd ſtring of wire at one end, the motion is immediately continued to the other. So far he entered into the nature of electricity,

Tho' he be in the right, thinking the cauſe comes from the air, yet what follows, contradicts his own hypotheſis. For if a calm be neceſſary before an earthquake; then 'tis not produc'd by any turbulence in the air. Nor can we imagine that any aerial commotion, tho' it may ſhake windows, chimneys, and the like, ſhall reach 500 miles diſtance, ſplit the ſolid earth, deſtroy whole cities, and cauſe thoſe dire deſolations we hear of.

Mr.

Mr. *Flamſted* mentions a circumſtance, that the earthquake here in 1692, was not felt in the north of *England*, nor in all *Scotland*: for rain fell that day in both. We may very readily conceive, the earth there was not in an electrified ſtate; and the rain would ſufficiently prevent it. We hence underſtand, how the ſouthern regions ſhould be more ſubject to them, than our northern; where the warmth, and drineſs of the air, ſo neceſſary to electricity, is more frequent than with us.

From electric vibration only can we account for our *tenth* poſition, of ſprings, and fountains being no ways damag'd by earthquakes: The motion goes no deeper into the earth, than the force and quantity of the ſhock reaches; which generally is not far; yet it proceeds lower down when the ready paſſage of a well offers, and *there* affects the water contained in it; puts it into an inteſtine vibration, as to foul it, and raiſe mud from the bottom.

It may ſeem difficult to conceive, how a large portion of the earth's ſurface ſhould be thus capable of electrification. This difficulty is leſſened by reflecting on the nature of electricity, and of the electrical, ethereal fluid pervading all things: how it is excited by the little motion of a ſmall revolving glaſs globe.

By this we electrify the moſt ſolid bodies, to the greateſt diſtance, and with a velocity equal to that of lightning.

Dr. *Hales* obſerves, that the uſual exploſion of the cannon on great days, in St. *James*'s-*Park*, is obſerv'd to electrify the glaſs, in the windows of the Treaſury.

We muſt conceive, that when the electric ſhock is communicated to one part of the earth, it extends itſelf proportionably to the force of the ſhock, and to the quantity of electrified ſurface; and to the quality of the matter more or leſs ſuſceptible of it, more or leſs apt to propagate it.

Set 1000 men in a row; let every one communicate with thoſe next him by an iron-wire held in their hands: on an electrical ſhock they all feel it alike, at the ſame inſtant; and this gives us a very good idea of the earthquake.

When the earth is broken up in any large degree, 'tis by the ſea-ſide; where ſometimes on a bold ſhore, whole ſtreets tumble into the ſea, or into the gaping earth, now falling toward the ſea. Sometimes on a flat and ſandy ſhore, whole ſtreets are rolled along the level into the ſea.

I am not ſenſible of any real objection againſt our *hypotheſis*, but this, being the *eleventh* of my poſitions, or circumſtances. It ſeems true, that earthquakes are more frequent

quent in *Italy*, near *Veſuvius*, and by *Ætna*, in *Sicily*. And the cauſe ſeems apparently owing to theſe vulcano's. At firſt ſight, every one would think ſo, but not from the true reaſon. This has given the great prejudice to the judgments of the curious, even at this day. But conſider the matter impartially, and it will appear, ſo far from being a ſtrong argument in favour of ſubterraneous eruptions, that it ought to be eſteem'd a convincing proof to the contrary, and moſt cogent in favour of my principle. In ſtricteſt logic, there is no inference to be made from particulars to generals. Quite the contrary. We have but theſe two or three vulcano's on one quarter of the globe, and two of them toward the warmer climate of it ; whereas earthquakes are innumerable, eſpecially in thoſe of a warmer clime. That there are no vulcano's, no diſcharges of fire and ſmoke for a continuance, and abundance, after earthquakes ; no ſuſpicion of it either from ſight or ſmell, as we know by innumerable examples, as well as in our own country, and experience: is demonſtration, that this is not the cauſe. If the vulcano's were the real cauſe of earthquakes, we ought aſſuredly to expect, that in the countries thereabouts, the earthquakes ought to be far more extenſive than thoſe in other countries, where are no vulcano's; but

this is altogether contrary to experience. For, as the celebrated naturaliſt *Buffon* obſerves, ſuch are not extenſive, as are near *Ætna* and *Veſuvius*. He further adds: *Hiſtoire naturelle*, tom. 1. p. 508. ſpeaking, among many others, of a *vulcano* in the iſland of *Ternate*, he remarks, "That this burning gulph is leſs "agitated when the air is calm, and the ſea-"ſon mild, than in ſtorms and hurricanes;" and ſays, "This confirms what I have ſaid in "my foregoing diſcourſe, and ſeems evident-"ly to prove, that the fire which makes *vul-*"*cano's* comes not from the bottom of moun-"tains, but from the tops, or at leaſt from "a very little depth; and that the hearth (or "floor) of the fire is not far from the ſum-"mit of the *vulcano's*; for, if this was not "the caſe, great winds could not contribute "to their conflagration." And this, in general, is a corroborative proof of my whole hypotheſis. For there can be no great fire in the earth, where there is no great conveyance of air.

We have one vulcano in the cold region of *Iceland*, and there is ſometimes an earthquake there; but, in the countries of that northern latitude, and thoſe of leſſer, 'tis obvious in all hiſtory, that earthquakes are leſs frequent than in the more ſouthern. Therefore 'tis eaſy, and very natural to conclude, from all

conſiderations weighed together, that theſe vulcano's help to put the earth about them, into that vibratory ſtate and condition of electricity, which is the requiſite in my *hypotheſis*; and by that means only, promote a frequency of earthquakes there.

I have only one circumſtance to add, which may ſeem not inconſiderable; probably perceived by many, tho' not taken notice of. For a whole week before the firſt earthquake, the partition wainſcot of my houſe (between the forward and backward rooms) made an odd kind of tremulous, crackling noiſe continually, as if the wainſcot would ſplit; or as if ſome damage was apprehended to the houſe. This was obſerv'd by the family, with a good deal of concern. *That* in the chamber crackled more than that below. We never perceiv'd it before, nor ſince; and apparently, it ſhows the vibratory ſtate of the ſurface of the earth, at that time.

But whether our conjectures upon this important ſubject be well founded or no, it certainly becomes a chriſtian philoſopher, whilſt he is inveſtigating material cauſes, to look up, and regard the moral uſe of them. For in reality, every thing, the whole world, was ultimately for that purpoſe made. When we ſee ſuch a kind of ſpirituality impreſs'd on mere matter, as this amazing property of electricity, it ſhould kindle in us a high ambition

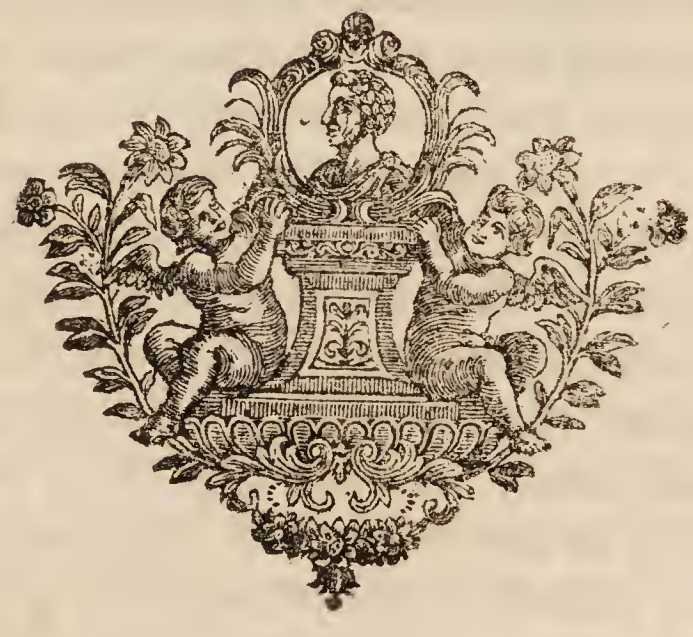
bition of aſſerting, and exerting the infinitely ſuperior value, and powers, and excellency of the ſpiritual part of us, deſtin'd to an immortal duration. And of all the great and public calamities, which affect us mortals, earthquakes claim the firſt title to the name of warnings and judgments. None ſo proper to threaten, or to execute vengeance upon a guilty people. Nor has any other, thoſe annexed terrors, ſo much of the unuſual, the unavoidable, the ſudden and the horrible apprehenſion of being cruſh'd to death, or buried alive. And when in our own ſight, theſe rare and extraordinary *phænomena* appear, it cannot but be a leſſon to us, to do our duty toward that great Being, who, by a drop of water, can produce effects ſo prodigious.

That earthquakes proclaim themſelves to mankind in this light, is further deducible from this obſervation, the *ninth* in our recapitulation of circumſtances; that they are peculiarly directed to great cities, and maritime towns, thoſe nurſeries of wealth, luxury, and of all the evils naturally flowing therefrom. It would be childiſh to rehearſe from old hiſtory, or modern, a proof of it. We have no other notices of them. Look upon theſe two ſhocks we have here felt. We own that *Hampſted-heath*, and *Finchley-foreſt*, and *Kennington-common* were affected with it; yet it is notorious, that *London* was the center,

the

the place to which the finger of God was pointed.

And this leads us in the *third* place, to conſider the moral uſe and purpoſe of theſe *magnalia naturæ*, and prodigies of the agency of material cauſes. For nothing ſure, but an electrical ſhock, and that from a divine hand, could have been ſo well adjuſted, as twice, nay four times, ſo ſenſibly to ſhake every houſe in *London*, and not throw one down. This duty we will endeavour to execute, from the words of that great man, king *David*.



PSALM xviii. 7.

Then the earth ſhook, and trembled; the foundations alſo of the hills moved, and were ſhaken; becauſe he was wroth.

THIS Pſalm is a triumphal ſong, which *David* deliver'd publickly before God, in thankful remembrance of the great mercies he had receiv'd; being firmly eſtabliſhed on his throne: and all his enemies, foreign or domeſtick, ſubdued.

He does not attribute this happy ſituation of his affairs to his own prudence and courage; but, like a conſummate politician, abſolutely to the mediation of the divine providence. He draws up a moſt grand and magnificent deſcription of the advent of the deity, ſuch as words never before expreſſed. All the heathen pictures of the appearance of their gods, are cold and lame, compar'd to this; which is deſervedly ſo much admir'd by all criticks that have any taſte for religion, as well as language.

This verſe, in our text, is the firſt movement in the ſcene, which was to repreſent the appearance of *Jehovah*, without whoſe interpoſition *David* hoped for nothing fortunate. After deſcribing all the pomp of light, and darkneſs,

darkneſs, celeſtial; hailſtones, thunder, lightning, and the like inſtances of majeſty and terror, in the skies; he ſtill keeps his eye on the ground, and concludes with the earthquake, where he began.

Then the channels of waters were ſeen; and the foundations of the earth were diſcovered; at thy rebuke, O Lord; at the blaſt of the breath of thy noſtrils.

Our holy pſalmiſt, at other times, has exhibited the ſame images, in different coloring; as a great maſter varies his works, to ſtrike out all the beauties.

Pſal. lxviii. 7. *O God, when thou wenteſt forth before thy people; when thou didſt march thro' the wilderneſs; the earth ſhook, the heavens alſo dropped, at the preſence of God. Even Sinai itſelf was moved, at the preſence of God; the God of Iſrael.*

By this he means, the giving the law. *Exod.* xix. 8. *And mount Sinai was altogether on a ſmoke; becauſe the Lord deſcended on it in fire: and the ſmoke aſcended as the ſmoke of a furnace, and the whole mount quaked greatly.*

Again, Pſal. cxiv. when he is deſcribing the paſſage over the *Red-ſea*, and that over *Jordan*; he brings in the machinery of earthquakes, to teſtify the divine preſence.

When Iſrael went out of Egypt, and the houſe of Jacob from among a ſtrange people;

the ſea ſaw it and fled. Jordan was driven back.

The mountains skipped like rams: and the little hills like young ſheep.

Then he asks the queſtion, *What ailed thee, O thou ſea, that thou fleddeſt? and thou Jordan, that thou waſt driven back?*

Ye mountains that ye skipped like rams, and ye little hills like young ſheep?

He anſwers: *Tremble thou earth at the preſence of the Lord: at the preſence of the God of Jacob.*

He fails not to attribute theſe marvellous appearances, to their true cauſe. Tho' he knew full well, that the God of nature adminiſtred the ordinary courſe of the earth by ſecond cauſes; yet he could not be ſo blind but to perceive, when the waves of the ocean retreated; when the waters of *Jordan* divided; when mount *Sinai* was all in fire, ſmoke, lightning and thunder, with the trumpet of God ſounding, and the whole mountain ſhaking: he could not but perceive the preſence of the author of nature, in theſe extraordinary appearances.

But every where in ſacred ſcripture earthquakes are particularly ſingled out, above all other natural *phænomena*, as having more of the majeſty and terrific pomp, to denote an immediate operation of God's hand; to excite our fear, and ſhew his anger, as in our text,

text, *becauſe he was wroth.* In imitation of the ſacred writers, the heathen poets, both *greek* and *latin*, expreſs the anger of their *Jupiter* by an earthquake:

Terrificam capitis concuſſit terque quaterque
Cæſariem; cum qua terram, mare, ſidera,
movit. Ovid.

The moving meteors in the free air, lightning, coruſcations, fire-balls, tempeſts, thunders, or the dreaded comets, tho' frightful enough; yet people that do not think to any purpoſe, hope, as they are at a diſtance, to eſcape their effects. But when the terror comes home to us, to our feet; when the earth moves on which we ſtand; what heart is not moved? When our houſes *ſhake* over our ears, the greateſt courage is *ſhaken.*

It is true, an earthquake cauſes an univerſal dread among all ſorts of people; even the philoſopher immerſed in ſpeculation of ſecond cauſes, quakes; as well as the pious, whoſe fear proceeds from ſolid piety: a due ſenſe of the *anger* of the almighty Being.

We ſaw how the late earthquakes affrighted every one; but, as to the generality, it was but for a moment. When they found themſelves ſafe, and alive; thoughtleſs they ran to their buſineſs, or their diverſion: and this not only the firſt, but the ſecond time. And I

am

am apprehenſive, were another, and another to come, they would only be leſs regarded than the preceding. As the *Iſraelites*, to whom miracles became familiar; as the *Jews*, in our Saviour's time, demanding of him to ſhow them a ſign from heaven, in the midſt of the conſtant ſcene of miracles innumerable.

But 'tis my preſent buſineſs to call you to a due and ſerious reflexion, on theſe extraordinary events; by conſidering,

I. What the written word of God, the holy ſcriptures, informs us, concerning the ultimate purpoſe of earthquakes.

II. What we can learn from profane hiſtory.

III. To conclude with our text, that they are ſtrictly and properly divine judgments; *becauſe he was wroth.*

Ever ſince the earth began, earthquakes have been look'd on as extraordinary appearances, among the prodigies of nature, and executioners of divine juſtice. In the caſe of *Korah*, *the earth opened her mouth and ſwallowed them up; and their houſes, and all the men that pertained unto them; and all their goods.*

In the miraculous victory obtain'd by *Jonathan*, and his armor-bearer, over the army of the *Philiſtines*, I. *Sam.* xiv. There was a panic terror infus'd into the *Philiſtines*, and an *earthquake*: it is call'd *a very great trembling*

of

of God. What the heathen attributed to *Pan*, an imaginary deity of their own making: the *Hebrews* rightly refer'd to the true cauſe, the firſt, and ſupreme.

In the new teſtament, at our Saviour's death, there was a great earthquake, which was altogether miraculous; as much as the eclipſe of the ſun then. The elements might well ſympathize with the God of nature. *The ſun was darkned, the vail of the temple was rent in twain; the earth did quake, the rocks rent.*

Again, at his reſurrection, *Matt.* xxviii. 2. *There was a great earthquake. The angel of the Lord deſcended from heaven, and rolled back the ſtone from the door, and ſat upon it.*

And for fear of him the keepers did ſhake, and became as dead men.

Matt. xxvii. 54. *When the centurion, and they that were with him, watching Jeſus, ſaw the earthquake, they feared greatly.* See the conſequence of it in one place; and thus in another:

Acts iv. 31. *The Apoſtles*, in the infant church, *when praying, the place was ſhaken, where they were aſſembled together: and they were all filled with the Holy Ghoſt.* The heathen centurion *feared* upon the earthquake: The chriſtians praying, were *filled with the Holy Ghoſt.*

Acts xvi. 26. When *Paul* and *Silas* were in priſon. *At midnight when they pray'd, and ſang hymns to God, ſuddenly there was a great earthquake; ſo that the foundations of the priſon were ſhaken. And immediately all the doors were opened, and every one's bands were looſed.*

Obſerve the conſequence it had upon the goaler; *He called for a light, and ſprang in, and came trembling, and fell down before Paul and Silas, and ſaid, Sirs, what muſt I do to be ſaved?*

The goal trembled; and the goaler trembled, as is obſerved by a writer on this head, an earthquake could *ſoften* his *hard* heart, and *open* what he had *lock'd.* It awaken'd him out of his ſpiritual ſlumber, as well as his natural ſleep, and made his conſcience, as well as the foundations of the priſon, to quake. A bad conſcience is *as a troubled ſea, that cannot reſt, but caſteth up mire, and clay.* The goaler perceiv'd the celeſtial warning, and made a proper uſe of it.

There are many circumſtances in the nature of earthquakes, which render them peculiarly proper to be the inſtruments in God's hand, to give warning to a people, to amend their ways.

The *ſuddenneſs* is one. We ſaw, not long ago, what an effect was produced by a ſolar eclipſe,

eclipſe, tho' it was expected long before. We had the prediction, and calculations about it in all our almanacs; yet there was an univerſal ſerioufneſs that followed it. All that morning, we could walk the ſtreet, without hearing an oath, and the churches were full, in time of prayer. But the *ſuddenneſs* of an earthquake that comes at an inſtant, unthought of, without warning, that ſeems to bring unavoidable death along with it; is able to touch an adamantin heart. To ſee death ſtalking o'er a great city, ready to ſweep us all away, in an inſtantaneous ruin, without a ſingle moment to recollect our thoughts; this is fear without remedy; this is far beyond battle and peſtilence. The lightning and thunderbolt, *the arrow that flieth by day*, may ſuddenly take off an object or two, and leave no ſpace for repentance: but what horror can equal that, when above a million of people are liable to be buried, in one common grave!

Another conſideration that inhances the dread of earthquakes, is the *unavoidableneſs* of the calamity. Famine, and war, and rebellion, and peſtilence we may run from, the diſeaſe among the cattle, and locuſts, and the like ſtripes of angry heaven, we may have ſome chance to eſcape: but no means, no precaution, no remedy, no prudence can ſcreen us, from ſo univerſal a deſolation as this: 'tis

as the preſence of God. Whither then can we go to hide ourſelves? Muſt we call upon the rocks and mountains, to cover, and ſhelter us from the divine wrath! *And they ſhall go into the holes of the rocks, and into the caves of the earth, for fear of the* LORD, *and for the glory of his majeſty; when he ariſeth to ſhake terribly the earth.* Alas, thoſe are the very inſtruments he employs for our deſtruction; to be our tombſtones!

This *unuſual* kind of death too, ſtrikes us with horror; to be buried alive. The earth, the common mother of us all, and the common grave; to eat up her offspring alive; crouds all the images of amazement together, that can enter into the heart of man.

The greater the terror accompanying earthquakes, the greater a bleſſing is our deliverance from the danger of it! What can equal God's power and judgment but his mercy? Conſider the wonderful conſequence; that the whole city of *London* ſhould ſo ſenſibly be ſhaken, and yet no one inhabited houſe to fall; nor one perſon kill'd. Amazing inſtance of power, and goodneſs, in our preſervation! And this not only once, but the ſecond time alſo; tho' evidently ſtronger was the concuſſion. So ſtrong that almoſt every perſon was throughly perſuaded, that ſome part, at leaſt, of their houſes, was falling down. Can we help

help admiring, that judgment ſhould be ſo temper'd with mercy! Do we look only at the ſecond cauſes with our unbelievers; and ſport away the divine preſence, as if it was an ordinary occurrence of every day? They want to ſee a miracle. Nought can affect them, but a direct, ſupernatural agency.

I anſwer, behold a viſible, and notorious miracle; plainly obvious, and before all their ſenſes. For can there be a greater miracle, can any thing be more directly the finger of God than this, which we ourſelves ſaw with our eyes; that befell the whole city of *London*.

We know the nature of the building of *London* houſes; which ſometimes fall of themſelves, without ſhaking. Wonderful then is it to be thought, and a miracle indeed, that every houſe in this vaſt city, ſhould twice be agitated, and rocked to and fro; and not one fall, nor one perſon receive any damage.

In vain will the philoſophers ſeek for a ſolution of this problem, in natural cauſes only. By their chymical experiments, they make ſome little mimic imitations of tremors and fumes, and exploſions. So by gun-powder, we ape the regal voice of thunder. But where is the diſcretionary act of mercy, and benignity, that ſeparates between the vengeful and kind? Theſe ſecond cauſes act according to their

material nature, like the roaring waves of the ocean, that flow in, and overwhelm every thing, where a breach is made. They can obſerve no diſtinction between the lands of a righteous man, and of a ſinner: they cannot ſtop at the breach, and gather themſelves on an heap, and not enter in at all, as the waters of *Jordan* did.

But in the caſe before us, the hand of the Lord, that ſtayed the flowing of the waters, that quelled the raging of the ſea, and its proud waves; ſets bounds to the trembling of the earth. Hither ſhall its vibrations go, and no further. When alas, if it went but one inch further (in compariſon) a total ruin muſt unavoidably follow.

Conſider this particular, when apply'd to all the buildings in this immenſe city: and wonder and adore, that almighty providence, which overlook'd us, and preſcrib'd the limits; ſo narrow, ſo preciſe; which ſav'd us from univerſal havoc!

II. Did we eſcape; how much happier are we, than the millions that have periſhed by the like calamity? *Joſephus* the famous *Jewiſh* hiſtorian records, that about 29 years before our Saviour's birth, there happened ſuch an earthquake in the country of *Judea*, that 30,000 men periſhed.

In

In the fifth year of the reign of *Tiberius*, ſo dreadful an earthquake happened in *Aſia minor*, that no leſs than 13 cities were deſtroy'd in one night; many of them great, and Royal: *Sardis* in particular, ſaid to be ſecond to *Babylon*.

In *A. D.* 66. Another earthquake happen'd there, which deſtroy'd *Laodicea*, *Hierapolis*, and *Coloſſus*.

A. D. 79. Three cities in *Cyprus* were overthrown.

A. D. 114. The city of *Antioch* ſuffered extremely; whilſt the emperor *Trajan* was in it. And in the 7th year of that emperor, nine ſeveral cities were deſtroy'd in *Aſia*, *Greece*, and *Calabria*.

To come nearer home, and our own times: In 1169, *Catania* in *Sicily* was deſtroyed, and 15,000 people killed.

1692, The whole city deſtroy'd and 18000 Inhabitants.

1456, At *Naples* 40,000 periſhed by an earthquake.

1531, In the city of *Lisbon*, 1400 houſes were overthrown there, beſides many damaged.

We know the miſerable and deplorable cataſtrophe of *Port-Royal*, in *Jamaica*; which fell out in our own days. My blood ſhudders at the relation of it. And not many

months ago, the populous *Lima* in *America*, was wholly ſwallowed up.

Have we not reaſon then to fear, for ourſelves? 'Tis true, we have hitherto eſcaped. But can we tell how ſoon God ſhall let looſe the avenging power of another; which may come, for ought we know, while we are ſpeaking of it. And if it muſt come, happy may it be for us, that it finds us in this place, and ſo doing.

III. And this brings us, to conſider the uſes of theſe admonitions; and to ſhow, that they are the effects of the divine anger. *For the earth ſhook and trembled*, ſays the holy pſalmiſt, *the foundation of the hills moved and were ſhaken; becauſe he was wroth.*

And here we cannot poſſibly have a ſtronger and more convincing evidence, of theſe convulſions of nature, being the immediate finger of God, than this ſingle conſideration. Let us but reflect on what has been ſaid, in ſhort; that theſe viſitations only happen to great and populous cities, to great and eminent ports, and maritime *emporiums* flouriſhing in trade, riches, and luxury.

We hear not of barren deſarts, uninhabited wilderneſſes, wide heaths, and downs, rocky cliffs, and beaches of the ſea, to be the uſual ſubject of earthquakes: but of towns and cities. Not ſo much of little villages, but

but of thoſe immenſe collections of people. God does not give his warnings to birds, and beaſts of the foreſt; to flocks of ſheep; that punctually execute the reſpective offices he has enjoined them: but to us, the lords of the creation; to whom he has given reaſon, ſenſe, and faculties, to reflect, and judge of things, of our own actions, as well as his; of *his* doings, toward the children of men.

We obſerved before, a plain and notorious proof of God's hand in theſe judgments; that he cou'd move a whole city without throwing down a houſe. And this is moſt aſſuredly a ſecond proof; that he viſits *only* great cities, with theſe judgments. And we muſt conclude this to be as ſtrong an argument of a divine interpoſition in theſe affairs, as any mathematical demonſtration.

Some free-thinkers, or free-livers, when they find, they cannot ſet aſide this reaſoning, ſhelter themſelves, with the hiſtory of God's converſe with *Abraham*; about the cities of *Sodom* and *Gomorrha*; aſſuring themſelves, there is no danger. For tho' they can't pretend to be the meritorious people; yet they think God's mercy will be as ſignal to us, as heretofore: and that we have among us, at leaſt ten righteous perſons, to ſave the reſt.

But

But vain are ſuch hopes: God will ſay to them, as heretofore to the *Jews*: *If I bring my great judgments upon the earth, as I live ſaith the Lord, tho'* Noah, Daniel, *and* Job *were there; they ſhould ſave neither ſons, nor daughters, but their own ſouls only.*

God can, if he pleaſes, by very extraordinary means, preſerve ſuch as he thinks fit. But in general judgments, the righteous muſt undergo one common fate, with the wicked. God's mercy will be ſhown to them after this life, to make the ſuperabundant amends.

But this is a ſolid leſſon to us, of the neceſſity of a future life. We may as well baniſh God out of the earth, as to deny his attributes of power, and goodneſs, and juſtice, and the like. And theſe will inſure us of a future ſtate; when an exact return will be made, for our behaviour in this; otherwiſe we might juſtly expoſtulate, as *Abraham* did, *Will not the judge of all the earth do right?*

Good men, who have endeavour'd to do their duty, may ſay, *God is our refuge and ſtrength, a very preſent help in trouble. Therefore will not we fear, tho' the earth be remov'd; tho' the mountains be carried into the midſt of the ſea; tho' the waters thereof roar, and be troubled; tho' the mountains ſhake with the ſwelling thereof.*

Come

Come behold the works of the Lord; what deſolations he hath made on the earth.

In the mean time, let us not think on running *away* from the danger, ſo much as on mending our *ways*; perfecting the chriſtian life; reforming the abominable crimes, ſo juſtly chargeable on great and maritime cities; overflowing with riches, pride, and luxury, with vanity, pleaſure, and profaneneſs; with gaming, immorality, infidelity; and eſpecially with the notorious crime of ſabbath-breaking, which is the foundation of all, and comprehends all others; for it prevents people from amending of any. If they fail of their duty towards God, in making their regular approaches to his temple; no wonder they are guilty of all crimes; regard neither God nor man. If they fail of coming, where they may hope for the kindly influences of God's holy Spirit; we need not wonder at their egregious wickedneſs: they become abſolutely irreclaimable.

But of you, my beloved brethren, here aſſembled, I hope better things. You ſhun the degenerate corruptions of this evil age; you are not of the number of thoſe that frequent our public meetings of folly, from the morning rendezvouzes to the mid-night aſſemblies; and *that* protracted to the morning light again. As if we ought to baniſh all ſe-

rious

rious thoughts of our immortal intereſts; and *that* in the ſacred ſeaſon of lent; deſtin'd by the church, for this very ſerious purpoſe.

Let us think, how this warning happen'd to us, in the time of lent; when they were revelling in their places of entertainment, both morning and evening, as if no ſuch thing had been; and this on the very days; as if they confronted, and dar'd almighty vengeance. Much of a parallel caſe with that of the famous city of *Herculaneum*, which is now the entertainment of the curious. Firſt it was miſerably ſhatter'd by an earthquake; whilſt the people were at their diverſions in the theatre; where all aſſembled periſhed. This was in the firſt year of *Titus* the emperor: but ſuch a partial judgment not mending their manners; 9 years after, the whole city was deſtroy'd by a lake of liquid fire and brimſtone, from mount *Veſuvius*, juſt in the manner we now find it; 50 foot deep in cinders, and aſhes.

When thy judgments, O God, are abroad, the inhabitants of the earth will learn righteouſneſs.

The Lord is the true God; he is the living God; the everlaſting King: At his wrath, the earth ſhall tremble, and the nations ſhall not be able to abide his indignation; ſays the prophet *Jeremiah*, x. 10.

God

God give us grace, that inſtead of theſe ſhort-liv'd, and unſatisfying pleaſures; inſtead of palaces and houſes here, ornamented in a ſumptuous and elegant *taſte*; which may perhaps be ſwept away, with their owners, in a moment; we may aſpire towards that heavenly city, which is above; whoſe foundations are not laid with hands, eternal in the heavens, *&c.*

FINIS.

THE PHILOSOPHY OF EARTHQUAKES, NATURAL and RELIGIOUS.

PART II.

Philoſophi ipſius, qui de ſua vi ac ſapientia unus omnia pene profitetur, eſt tamen quædam deſcriptio; ut is qui ſtudeat omnium rerum divinarum atque humanarum vim, naturam, cauſaſq; noſſe: & omnem bene vivendi rationem tenere, & perſequi; nomine hoc appelletur.

Cicero de Oratore.

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MDCCL.

PREFACE.

THIS diſcourſe is but a neceſſary conſequence of the preceding. The whole no other than an eſſay, toward inveſtigating the true nature of the wonderful appearance of an earthquake. And ſomething is done toward it, if only by eradicating an old error. In attaining the propoſed end, I have endeavour'd to lay all the neceſſary circumſtances together, which to our great amazement we have ſeen, and felt. That they may not be as ſoon forgotten, as they generally were, by the giddy multitude; equally thoughtleſs of what they knew to be paſt, as childiſhly fearful of an imaginary one, ſubſequent: for which there could not be the leaſt ground of apprehenſion. By ſober perſons it was, with great reaſon, thought a judicial infatuation, and as much to be wonder'd at, as an earthquake itſelf; a real panic. When a third part of this immenſe city ran out into the fields for half a cold night; alarm'd with the ſilly prediction of a diſtemper'd fellow!

Nothing could tempt one to commemorate the follies of our cotemporaries, but the hope,

it may be useful hereafter: and to show the true cause of this senseless terror; the want of a true sense of religion; and an universal degeneracy, and corruption of manners: begun by the great ones, and now propagated thro' all degrees to the lowest: begun in this great city; and now advancing apace to every great town in the kingdom.

'Tis from the great ones alone, that we can hope for a reformation: and that *by a strict observance of the sabbatical duty. Example, we know, governs the actions of mankind.* That *must restore the practice, and the influence of religion: which alone can prevent the dangers that infest every corner of our streets; every road in the kingdom. We mistake the point, and betray our ignorance in human nature, when we think, acts of parliament, laws, and executions will do it. They are very weak in comparison of the impressions of religion, and conscience: as all philosophy both natural and religious, has hitherto thought, and known.*

TO

TO

Martin Folkes, Eſq; LL. D.

Preſident of the Royal Society.

SINCE I had the honour to lay before the Society, in the ſpring, my thoughts upon earthquakes: we have had many further opportunities of reflecting upon that moſt awful, and hitherto unuſual appearance. An earthquake was felt at *Eaſtwell* in *Kent*, on *monday march* 12, and on *ſunday*, *march* 18, at *Portſmouth*, the *Iſle of Wight*, *Southampton*, and along the coaſt of *Suſſex*, the iſles of *Guernſey*, *Jerſey*. *April* 2, a ſmart earthquake at *Mancheſter*, *Liverpool*, *Taunton*, *Bath*, *Flint*, *Lancaſter*, *Wrexham*, reaching 40 miles north and ſouth: 70 miles eaſt and weſt. Since then at *Rome*, *Naples*, *Leghorn*; in the ſouth of *France*, and at *Pau* under the *Pyrenean* mountains: *Oporto*, at *S. Macaire* in *Guienne*, *Meſſina* in *Sicily*, *Munich* in *Bavaria*, &c. &c. ſo that the year 1750, may rather be called the year of earthquakes, than of jubilee. For ſince

February laſt, when they began with us at *London*; as far as I can learn, they have appear'd in many parts of *Europe*, *Aſia*, *Africa*, and *America*. And have likewiſe reviſited many counties in our own iſland, and at length, on the 30th of laſt *ſeptember* gave much the moſt extenſive ſhock, we have ſeen here in our days.

It may be well expected, that theſe frequent viſits, in themſelves ſo very extraordinary, to us ſo rare, and *that* in one year, ſhould keep up our attention: and as to my own part, induce one to reflect, on what I before offer'd concerning them; and be a ſufficient apology for the preſent paper.

We have been acquainted, by thoſe who remember it, that in the earthquake of *nov.* 1703, which happen'd in *Lincolnſhire*, the weather was calm, cloſe, gloomy, warm, and dry; in a degree highly unuſual, at that ſeaſon. And thus it has been with us, all the year. And from the numerous accounts we have receiv'd at the Royal Society, in the beginning, and ending of the year; where any mention is made of the weather; they all agree in the like particular. Which is conſentaneous to what I remark'd, as the conſtant forerunner of earthquakes; and what prepares the earth's ſurface, for the electrical ſtroke: which I aſſerted to be the cauſe of them.

In

In *may* laſt, we had a paper read at the Royal Society, concerning the ſecond earthquake felt by us at *London*, on the 8th of *march*. A ſhepherd belonging to Mr. Secretary *Fox* at *Kenſington* (the sky being perfectly ſerene, and clear) was much ſurpriſed with a very extraordinary noiſe in the air, rolling over his head, as of cannon cloſe by. He likewiſe thought, that it came from the north-weſt, and went to the ſouth-eaſt: a motion quite contrary, to what muſt have been the caſe, if it were really of cannon. This noiſe paſs'd ruſhing by him; and inſtantly he ſaw the ground (a dry, and ſolid ſpot) wave under him, like the face of the river. The tall trees of the avenue, where he was, nodded their tops very ſenſibly, and quiver'd like a ſhaken ſpear. The flock of ſheep immediately took fright, and ran all away together, as if dogs had purſued them. A great rookery in the place, were equally alarm'd, and after an univerſal clangor, flew away; no leſs than if chaced by hawks.

I was likewiſe inform'd, that in the ſame earthquake, a great parcel of hens, and chickens, kept at that time in *Gray's-inn-lane*, upon the ſhock, ran to the rooſt, affrighted. And the like was obſerv'd of pigeons. And in our laſt account of the earthquake from *Northampton*, 'tis remarked, that the birds in

cages put their heads under their wings, as to hide themſelves.

June 21, at the Royal Society, Mr. *Jackſon* potter at *Lambeth*, gave an account of ſome boats, cobles and lighters in the river, at that time; the people in them ſeem'd to feel, as if a porpoiſe, or ſome great fiſh had heav'd and thump'd at the bottom of the veſſels. This is ſometimes the caſe of ſhips at ſea, when all is perfectly calm: which ſeems evidently owing to an electrical impreſſion on the water.

In the evening-poſt of *june* 23, we had a paragraph from *Venice*, that a terrible earthquake had been felt lately in the little rocky iſle of *Cerigo*, in the *Mediterranean*, ſouth of *Morea*. It threw down a great number of houſes; and above 2000 of the inhabitants were buried in the ruins.

Another earthquake about that time, happen'd in *Switzerland*; which ſplit a vaſt, rocky mountain; and an old caſtle wall of an immenſe thickneſs.

All theſe circumſtances, and many more confirmed me in my former opinion. But ſince then, theſe wonderful movements have ſtalk'd round the globe: and again been lately felt in our own iſland; happily for us, to the terror only, of many thouſand people: beſide thoſe concuſſions of this ſort that appear'd in the weſtern parts, in the more early time of the year.

I receiv'd a letter from my friend *Maurice Johnſon*, Eſq; the founder, and ſecretary of the Literary Society of *Spalding*; which has now ſubſiſted theſe 40 years. He acquaints me, that on *thurſday*, 23d of *Auguſt* laſt, an earthquake was very ſenſibly felt there, about ſeven o'clock in the morning; throughout the whole town and neighbourhood; and many miles round: but that it chiefly ſpread itſelf northward, and ſouthward. He ſays, that for a fortnight before, the weather had been ſerene, mild, and calm. And one evening, there was a deep red *aurora auſtralis*, covering the cope of heaven, very terrible to behold. This ſame ſhock was felt at *Grantham*, *Stamford*, and *Milton* by *Peterborough*; and generally at all the intermediate places: and from *Spalding* it fled northward, along the ſea ſhore, to *Boſton*: thence up *Boſton* river, to *Lincoln*.

Since then, I had a letter from Mr. Alderman *Taylor* of *Stamford*, giving an account of another earthquake, that happen'd there, *ſeptember* 30, at 36 minutes after twelve o'clock at noon. He deſcribes it thus. They were ſuddenly ſurpriſed with an uncommon noiſe in the air, like the rolling of large carriages in the ſtreets, for about 20 ſeconds. At the ſame inſtant they felt a great ſhake, or ſnap, as he calls it; inſomuch that it ſenſibly ſhook a punch-bowl, which was in his parlour, and made

made it ring. He ſays, it was perceiv'd of moſt of the people of *Stamford*, who generally ran out of their houſes. At *Oakham* the chief town of *Rutland*, the congregation ran out of the church whilſt the preacher was in the pulpit. All the towns round *Stamford*, were ſenſible of it: and at *Peterborough*, down to *Wiſbech*.

Thus far the Alderman. But we have had many advices from all hands, at the firſt, and ſecond meetings of the Royal Society, for the winter ſeaſon; with further particulars relating to this great concuſſion. That it was felt at the ſame time, at *Rugby* in *Warwickſhire*, and reach'd to *Warwick*, at *Lutterworth*, in *Leiceſterſhire*: at *Leiceſter*, and round about. It extended itſelf to *Coventry*, *Derby*, *Nottingham*, *Newark*; then came eaſtward to *Harborough*, *Towceſter*, *Northampton*, *Rowel*, *Kettering*, *Wellingborough*, *Oundle*, in *Northamptonſhire*; *Uppingham*, *Oakham* in *Rutland*; *Stamford*, *Bourn*, *Grantham*, *Spalding*, *Boſton*, and to *Lincoln* in *Lincolnſhire*; *Holbech*, and all *Holland* in that county. *Peterborough*, *Wiſbech*, in the iſle of *Ely*; together with all the intermediate, and adjacent places. Then it paſſed over the whole breadth of *Ely* fen: was felt at *Mildenhall*, and reach'd to *Calford* by *Bury* in *Suffolk*, and the country thereabouts; of which we had notice from lady *Cornwallis*. An extent from

Warwick

Warwick to *Bury* of about 100 miles in length; and generally ſpeaking, 40 miles in breadth. And this vaſt ſpace was pervaded by this amazing motion, as far as we can get any ſatisfaction, in the ſame inſtant of time. They deſcribe it, that the houſes totter'd, and ſeem'd to heave up, and down: tho' it laſted but a few ſeconds. It was attended with a ruſhing noiſe, as if the houſes were falling, and people were univerſally ſo affrighted, as to run out; imagining that their own, or their neighbours houſes were tumbling on their heads. In the villages around, the people being generally at divine ſervice, were much alarm'd: both with the noiſe, which exceeded all the thunder they had ever heard, beyond compare: and with the great ſhock accompanying; which was like ſomewhat, as they imagin'd, that ruſh'd againſt the church-walls, and roof. Some, thinking the pillars crack'd, many that the beams of the roof were disjointed; and all, that the whole was falling. And happy were they that could get out firſt. Many people fancied, that neſts of drawers, and cabinets, or the like heavy things, were fallen down above ſtairs: or that chimnies had broke thro' the roof of the houſe: or that ſome perſons fell down ſtairs: and the like. Some perceived the crackling of inward wainſcots or partitions: as Dr. *Mortimer* and I, obſerv'd in our firſt and ſecond

ſhocks

ſhocks at *London*. A few ſlates, tiles, and parts of chimneys fell from ſome houſes: pewter, china, glaſſes and braſs from ſhelves. A clock bell, chamber bell ſometime ſtruck: windows univerſally rattled, and the like circumſtances of tremor.

In regard to circumſtances, they were pretty ſimilar throughout. Many people ſitting in their chairs relate, that they and their chairs were ſeveral times ſenſibly lifted up and ſet down again. A ſtack of chimneys were thrown down in *College-lane*; a place retaining the memory of a ſort of univerſity once beginning at *Northampton*. The windows of houſes rattled throughout the whole town: but no miſchief done: in general it was frightful, and innocuous.

They fancied there, the motion of it, as they expreſſed it, to be eaſtward. In ſtreets that run north and ſouth, the houſes on the eaſt ſide of the way, were moſt affected. And Dr. *Stonehouſe*'s dwelling, the ſtrongeſt in the town, was moſt ſenſibly ſhaken. So it was likewiſe obſerv'd, that churches were moſt ſubject to its violence. They thought too, that the motion ſeem'd rather horizontal, or lateral, than upward. Some counted the pulſes diſtinctly, to the number of four: that the ſecond, and third pulſes were ſtronger, than the firſt, and fourth.

From

From all theſe various accounts, there was no ſulphureous ſmell, or eruption; no fiſſures in the ground perceived. Yet ſeveral people were ſick upon it: infinite numbers terribly affrighted, and as ſoon forgot the impreſſion of it; or talk'd of it in a merry ſtrain; as commonly with us at *London*. So little are the vulgar affected, without ſomething very ſenſible; and ſo ſoon is the ſenſe of it worn out!

It was more evidently perceiv'd, by people ſtanding; moſt, by thoſe that were ſitting: leaſt, by ſuch as were walking: and in upper ſtories of houſes, more than in lower; or in cellars. Some coming down ſtairs, were in danger of being thrown forwards. Several ſitting in a chair, and hearing the hollow, thundring noiſe, and thinking it was a coach paſſing by; when they attempted to get up, to ſee what it was, they were thrown back again in their chair. Some heard the wainſcot crackle. Some ſitting in their chairs leaning forwards, were thrown down on their hands, and knees. Some people heard the noiſe without feeling the ſhock: others felt the ſhock without hearing the noiſe. Some in a ſtanding poſture, were forc'd to lay hold on a table, to keep themſelves from falling.

It was particularly remarked (as before obſerv'd) that birds in cages were ſenſibly affrighted; thruſting their heads under their wings.

wings. Mrs. *Allicock* of *Loddington*, *Northamptonſhire*, a lady in child-bed, was ſo affected, that it cauſed her death. Mrs. *Hardy*, another lady in the ſame circumſtance, and in the ſame county, likewiſe expired upon it. Some people felt a ſudden ſhortneſs of breath, that they were forc'd to go out into the open air, it ſo affected the pulmonary nerves. Many were taken with head-achs, and other ſickneſſes.

Theſe are, in general, the circumſtances and obſervations made, at the time of theſe earthquakes; when we recollect ourſelves, after the ſuddeneſs, and fright. Give me leave to make the following remarks therefrom.

1ſt. As far as we can poſſibly learn, where no one can be prepar'd, at different places, by time keepers; this mighty concuſſion was felt preciſely at the ſame inſtant of time; being about half an hour after twelve at noon. This, I preſume, cannot be accounted for, by any natural power, but by that of an electrical vibration; which, we know, acts inſtantaneouſly.

2dly, Let us reflect on the vaſt extent of this trembling, 100 miles in length, 40 in breadth, which amounts to 4000 ſquare miles in ſurface. That this ſhould be put into ſuch an agitation, in one moment of time, is ſuch a prodigy; as we ſhould never believe, or conceive,

conceive, did we not know it to be fact, from our own ſenſes. But if we look for a ſolution of it, we cannot think, any natural power is equal to it, but that of electricity; which acknowledges no ſenſible tranſition of time; no bounds.

3ly, We obſerve, the vulgar ſolution of ſubterraneous eruptions receives no countenance, from all that was ſeen, or felt, during theſe earthquakes. It would be very hard to imagine, how any ſuch thing could ſo ſuddenly, and inſtantaneouſly operate, thro' this vaſt ſpace: and *that* in ſo ſimilar, and tender a manner over the whole, thro' ſo great a variety, as well as extent of country; as to do no miſchief. A philoſophical inquirer in *Northamptonſhire*, who had his eye particularly on this point, takes notice, there were not any fiſſures in the ground; any ſulphureous ſmells, or eruptions any where perceiv'd; ſo as to favour internal convulſions of the earth. The reverend Mr. *Nixon* of *Higham*, and Mr. *Smith*, in his letter from *Peterborough* take notice, that they could not learn, there were any ſort of eruptions out of the earth, any where: no ſmoke, vapor, or ſmell: tho' they made ſufficient inquiry about that circumſtance, according to particular direction. Yet we learn from a letter at *Uppingham* in *Rutland*, that a plaiſter floor became crack'd thereby. Theſe kind of floors are frequent

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in this country; what we call *ſtucco* in *London*: and it gives us a good notion of the undulatory vibration, produc'd by an earthquake; which ſome have compar'd to that of a muſical ſtring: others to that of a dog, or a horſe ſhaking themſelves, when they come out of the water. This laſt compariſon would have pleaſed ſome of the ancients, who would needs fancy, that the globe of the earth was a great animal. *Plato*, *Plutarch*, and others, had ſuch kind of ſentiments. Whence one may imagine, that they would conceive an earthquake to be, as when a horſe ſhakes a part of his skin, upon a fly touching him. Some of our correſpondents expreſs the motion of an earthquake to be like a boat lifted up by one wave, let down by another.

4ly, The former earthquake that happen'd at *Grantham*, *Spalding*, *Stamford*, (which towns lie in a triangle) took up a ſpace which may, in groſs, be accounted a circle of 30 miles diameter: the center of which is that great moraſs, called *Deeping-fen*. This comprehends 15 miles of that 30, in diameter: and where probably, the electrical impreſſion was firſt made. Much the major part of *Deeping-fen* is under water in the winter time; underneath 'tis a perfect bog. Now it is very obvious, how little favorable ſuch ground is, for ſubterraneous fires.

In

In the ſecond earthquake, not only this country was affected again, but likewiſe a much larger ſpace of the ſame ſort of fenny ground, rather worſe than the former: all *Donnington-fen*, *Deeping-fen*, *Croyland-fen*, *Thorney-fen*, *Whitleſea-fen*, *Bedford* level, and the whole extent of *Ely-fen*, under various denominations. This country, under the turf, abounds with ſubterraneous timber of all ſorts; fir, oak, and bruſh-wood: and ſtags horns. Now and then they find a quantity of hazel nuts, crouded together on an heap. I have ſome of them. This is a matter common to all boggy ground over the whole globe, Such things are the ruins of the *antediluvian* world, waſhed down from the high country where they grew, were here lodg'd upon the ſubſiding of the waters, and by time are o'ergrown with the preſent turf. They that ſeek for any other ſolution of this affair, than the univerſal *Noachian* deluge, want to account for a general effect, by a partial cauſe: and ſhut their eyes, both to the plain hiſtory of this matter; and to the infinite, notorious demonſtrations of it, from foſſil appearances.

5ly, All this country, tho' underneath 'tis a watry bog, yet thro' this whole ſummer, and autumnal ſeaſon (as they can have no natural ſprings in ſuch a level) the drought has been ſo great on the ſuperficies, that the inhabi-

tants were oblig'd every day, to drive their cattle ſeveral miles, for watering. The drought was greater, than has been known in the memory of any one living. This ſhows how fit the dry ſurface was, for an electrical vibration. And we learn from hence, this important particular, that it reaches but very little below the earth's ſurface.

Mr. *Johnſon*, in another letter which he wrote to me concerning the ſecond earthquake obſerv'd at *Spalding*; ſays upon this occaſion, he was obliged to ſcour his canal, and deepen it: that they came to a white, quickſand; which afforded to all the neighbourhood, excellent water in plenty.

In the gravelly ſoil of *London*; and where the two ſhocks were felt by us, in the beginning of the year; we know, there is not a houſe in the whole extent of this vaſt city, and all around it, but a ſpring of water is ready, upon digging a well. Whence we have much reaſon to believe, that the interior of the earth, is like a ſponge ſoak'd in water. So that the only dry part is the ſuperficies, which is the object, and the ſubject of that electric vibration; wherein, according to my ſentiments, an earthquake conſiſts.

This ſhews the miſtake of the ancients, who fancying that earthquakes proceeded from ſubterraneous eruptions, built their prodigious temple of *Diana* at *Epheſus*, upon a boggy ground,

ground, to prevent ſuch a diſaſter. The marſhy part of *Lincolnſhire*, being my native country, the adjacent fen, together with that in the iſle of *Ely*, I have been perfectly acquainted with; from one end to the other, ever ſince I knew any thing. This vaſt extent of fenny level, from near *Cambridge* in the ſouth, to near *Horncaſtle* in the north, is 70 miles in length. And when I perceiv'd, that it was, in whole, or in part, ſhaken by both the laſt earthquakes: I could not but ſee, that it was no leſs than a demonſtration againſt the old notion of their cauſe.

6ly, Earthquakes are truly moſt violent, in a rocky country: becauſe the ſhock is proportionate to the ſolidity of the matter electrify'd. So that rocks, cliffs, quarries, old caſtle walls, and ſtrong buildings, are moſt obnoxious to the concuſſion. The iſle of *Cerigo* was more liable, and more rudely handled by the late earthquake; both becauſe it was an iſle, and becauſe it was rocky. So we muſt ſay of the late earthquake in *Switzerland*, that ſplit the mountain, and the old caſtle wall. Whence Mr. *Johnſon* in his ſecond letter, ſays, it cracked a very ſtrong brick-houſe in *Goſberton* by *Spalding*. Dr. *Doderidge* obſerves from *Northampton*, that Dr. *Stonehouſe*'s dwelling being a very ſtrong one, was moſt ſenſibly ſhaken. And throughout the whole compaſs of this great earthquake, we find, both

the noiſe, the ſhock, and the terror was greateſt at the churches, whoſe walls and bulk made more reſiſtance than houſes. And generally ſpeaking, the churches throughout this whole extent have very fair, and large towers, and very many remarkable ſpires all of good ſtone, which no doubt quiver'd very much at top, if we could have diſcern'd it. This ſame vibration impreſſed on the water, meeting with the ſolid of the bottom of ſhips, and lighters, gives that thump felt thereon; juſt as in common electrifying, we feel the ſtroke upon the joints of our limbs chiefly. Yet of the millions of ordinary houſes, over which it paſſed, not one fell. A conſideration which ſufficiently points out to us, what ſort of a motion this was not, what ſort of a motion it was, and whence deriv'd; not a convulſion of the bowels of the earth, but an uniform vibration or undulation of its ſurface, aptly thought like that of a muſical ſtring: or what we put a drinking glaſs into, by rubbing one's finger over the edge; which yet brought to a certain pitch, breaks the glaſs; undoubtedly an electric repulſion of parts. And from this remarkable ſimilarity in the appearance of earthquakes we gather an invincible argument againſt the old opinion of their cauſe; for the tumult of ſubterraneous eruptions can have no poſſible place herein.

7ly, We find from all accounts, ancient and modern, that the weather preceding theſe ſhocks, was mild, warm, dry, ſerene, clear, froſty: what notoriouſly favours all our electrical experiments. This is particularly obſerv'd by Mr. *Johnſon* and Mr. *Smith*, and other accounts. In the extenſive ſhock of *ſunday march* 18, along the *Suſſex* coaſt, they take notice from *Portſmouth*, that the day was ſerene, warm, and dry, and that a ſhower of rain fell immediately before the ſhock. Mr. *Bowman* of *Moulſey* obſerv'd a ſhock there on *may* 24 laſt, and ſays, the air was perfectly ſerene, and clear. We very well know, that generally, all laſt winter ſpring, ſummer, and autumn, have been moſt remarkably of this kind of weather; more ſo, than has been obſerv'd in our memory; and have had all thoſe requiſites, appearances, and preparations, that notoriouſly cauſe electricity, that promote it, or that are the effects of it.

8ly, We find the blood-red *auſtralis aurora* preceding at *Spalding*, as with us at *London*. At the time of the earthquake at *Mancheſter* this year, it accompanied it. And this year has been more remarkable than any for fire-balls, ſtorms, wind, thunder, lightnings, and coruſcations, almoſt throughout all *England*. A large ball of fire, with a long fiery tail on *july* 22, that paſſed over great part of *England* northward. Another ſeen over *London*,

paſſing from weſt to eaſt, in *october*. Coruſcations were ſeen juſt before that extenſive ſhock of 70 miles long felt from *Lancaſter* to *Wrexham*, on *april* 2, laſt. Fire-balls more than one were ſeen in *Rutland*, and *Lincolnſhire*: and particularly obſerv'd. And Mr. *Smith* from *Peterborough* writes, that a fire-ball was ſeen the morning of the earthquake, in the upper part of *Northamptonſhire*. All theſe kind of meteors are rightly judg'd to proceed from a ſtate of electricity in the earth and atmoſphere: and how far they are actually concerned in cauſing earthquakes, time, and accurate obſervation muſt inform us.

9ly, Mr. *Johnſon* in both his letters to me, on the firſt and ſecond earthquakes, at *Spalding*, remarks particularly, of their effects being moſtly ſpread to the north and ſouth, and eſpecially felt on the ſea coaſt. We may obſerve, that ſuch is the direction of *Spalding* river, which both conducts, and ſtrengthens the electric vibration: conveying it along the ſea-ſhore thence, up to *Boſton* channel; and ſo up *Boſton* river to *Lincoln*, as we diſcern, by caſting our eye on a map.

We obſerve further, that the main of this ſecond earthquake diſplay'd its effects along, and between the two rivers, *Welland* and *Avon*: and *that* from their very origins, down to their fall into the ſea. It likewiſe reach'd the river *Witham*, which directed the electric ſtream

that

that way too, to *Lincoln*. For which reaſon, as there meeting the ſame coming from *Boſton*, the ſhock was moſt ſenſibly felt. It reach'd likewiſe to the *Trent* at *Nottingham*, which convey'd it to *Newark*.

The firſt electrical ſtroke ſeems to have been made on the high ground above *Daventry*, in *Northamptonſhire*; where the *Roman* camps are, made by *P. Oſtorius* the proprætor. From thence it deſcended chiefly eaſtward, and along the river *Welland*, from *Harborough* to *Stamford*, *Spalding*, the ſea: and along the river *Avon*, or *Nen*, to *Northampton*, *Peterborough*, *Wiſbech* to the ſea. It ſpread itſelf all over the vaſt level of the iſle of *Ely*; further'd by very many canals, and rivers, natural, and artificial, made for drainage. It was ſtill conducted eaſtward up *Mildenhall* river, in *Suffolk*, to *Bury*, and the parts adjacent. All this affair duly conſider'd, is a confirmation of the doctrine I advanc'd on this ſubject.

1oly, I apprehend, it was not the noiſe in the air, as of many cannon let off at once, preceding the earthquake, that ſo much affrighted people, or affected the ſheep, the rookery at *Kenſington*, the hen and chickens in *Gray's-inn-lane*, the pigeons. It could not be barely the ſuperficial movement of the earth, that diſturb'd them all at once. I judge it to be the *effect* of electricity, ſomewhat like what cauſes ſea ſickneſs; ſuch a ſort of motion, as we are

not accuſtomed to. So the earthquake affects all thoſe of weak nerves, or that have nervous complaints; obnoxious to hyſterics, colics, rheumatick pains in their joints; ſeveral women were ſeized with violent head-achs, before both the ſhocks we felt in *London*. It was this that gave the people a ſhortneſs of breath. Mr. *Smith* from *Peterborough* ſpeaks of a perſon that found himſelf very ſick upon it. This made the dog run whining about the room, ſeeking to get out: this made the fiſhes leap up in the pond at *Southwark*; like as the experiment of electrifying the fiſhes: it makes them ſick. And this cauſes the birds in cages to hide their heads under their wings, becauſe they cannot fly away. Which is commonly obſerv'd of them in *Italy*, and countries, where earthquakes are more frequent.

11ly, I obſerve, the ſhepherd at *Kenſington* thought the motion of the earthquake, and the ſound, was from the north-weſt to ſouth-eaſt; the like Mr. *W. Smith* from *Peterborough*. On the contrary, Mr. *Byfield* the ſcarlet dyer in *Southwark*, thought the noiſe came from the river below bridge, and went toward *Weſtminſter*; where it rattled ſo, that he did not doubt, but that the abbey-church was beaten down.

Dr. *Parſons* took pains to find out the way of the motion of the earthquake, from the different poſition of people's beds; but from the contra-

dictory

dictory anſwers given, he cou'd not obtain any ſatisfaction, as to that point. All this, and what was obſerv'd from *Northampton*, of the motion being thought by ſome, to be upward and downward; by others rather horizontal, or lateral: the counting the pulſes, and the like, only points out to us the prodigious celerity, and the vibratory ſpecies of the motion of an earthquake. But far, very far is this from being owing to the tumultuous ebullition, the irregular hurry of ſubterraneous exploſions.

12ly, How the atmoſphere, and earth, are put into that electric and vibratory ſtate, which prepares them to give, or receive the ſnap, and the ſhock, which we call an earthquake; what it is, that immediately produces it, we cannot ſay: any more than we can define, what is the cauſe of magnetiſm, or of gravitation; or how muſcular motion is perform'd, or a thouſand other ſecrets in nature.

We ſeem to know, that the author of the world has diſſeminated ethereal fire, thro' all matter, by which theſe great operations are brought about. This is the ſubtil fluid of Sir *Iſaac Newton*, pervading all things: the occult fire diffuſed thro' the univerſe, according to *Marſilius Ficinus* the platonic philoſopher, on the *Timeus* of his maſter. All the Platoniſts inſiſt on an occult fire paſſing thro', and agitating all ſubſtance, by its vigorous and expanſive motion.

Before

Before them, *Hippocrates* writes in the ſame ſenſe, *I. de victûs ratione*, that this fire moves all in all. This ethereal fire is one of the four elements of the ancients. It lies latent, and diſperſed thro' all the other three, and quieſcent: till collected into a quantity, that overbalances the circumjacent; like the air crouded into a tempeſt: or till it is excited, by any proper motion.

This fire gives elaſticity: and elaſticity or vibration is the mother of electricity. We don't ſo much wonder at phoſphorus ariſing from animal ſubſtances; for this fire is in water, and betrays itſelf to our ſenſes, in ſalt water. Many a time when I have paſſed the *Lincolnſhire* waſhes, in the night time; the horſe has ſeem'd to tread in liquid flames. The ſame appearance is oft at the keel of a ſhip. Fire exiſts in water, ſays *Pliny*, as well as in human bodies. *nat. hiſt.* II. 107. Loaf ſugar beaten in the dark is luminous. Many vegetables, as indian cane, and rotten wood the like, as *Bartholin* largely recites, *de luce hominum* c. 4. All electric bodies have this privilege: that is, they more eaſily diſcover it. Amber, gum lac, naptha, bitumens, ſome precious ſtones. My old friend Mr. *Stephen Gray* the father and great propagator of electricity, ſhow'd me experiments therein, in the year 1705, then at *Corpus Chriſti* college in *Cambridge*. Afterward in the year 1719, he ſhow'd by experiments

ments before the Royal Society, that paper, ribbands, ſilk, ſattin, cloth, ſhavings, linen, goldbeaters skin, and in ſhort, almoſt all kind of ſubſtances diſcover electrical ſparks of fire in the dark: eſpecially when well warm'd before the fire, or in a cold, dry, nitrous air, and in a room where there is no company. This ſame quality is found *in vacuo*, as Dr. *Deſaguliers* ſhow'd before the Royal Society, *march* 31, 1720. He took an exhauſted glaſs globe, and cauſed it to be turn'd round violently, in an engine: by rubbing the hand upon it, it was illuminated within ſide, with purple ſtreams. This gave foreigners the idea of uſing a glaſs globe, in electrical experiments.

The operation of the ethereal fire is various, nay, infinite, according to its quantity, and degree of incitement, progreſs, hindrance, or furtherance. One degree keeps water fluid, ſays the learned biſhop of *Cloyne*: another turns it into elaſtic air, and air itſelf ſeems nothing elſe, but vapors, and exhalations render'd elaſtic, by this fire.

This ſame fire permeates, and dwells in all bodies; even diamond, flint, and ſteel. Its particles attract with the greateſt force, when approximated. Again, when united, they fly aſunder, with the greateſt force, and celerity; it reſiſts nothing quieſcent, but when put into motion, it diſdains all reſiſtance. All this is according to the laws preſcrib'd by the ſovereign architect.

architect. This is the life, and ſoul of action, and reaction, in the univerſe. Thus has the great author provided againſt the native ſluggiſhneſs of matter! light, or fire in animals, is what we call the animal ſpirits; and is the author of life, and motion. But we know not the immediate mode of muſcular motion; any more than how, in inanimate matter, it cauſes the vibrations of an earthquake.

Of this fire, the excellent *Manilius* thus writes, who liv'd in the time of *Auguſtus*.

Aſtronom. I.

Sunt autem cunctis permiſti partibus ignes;
Qui gravidas habitant fabricantes fulmina nubes:
Et penetrant terras, Ætnamq; imitantur Olympo:
Et calidas reddunt ipſis in fontibus undas.
Ac ſilice in duro, viridiq; in cortice ſedem
Inveniunt; cum ſilva ſibi colliſa crematur.
Ignibus uſq; adeo natura eſt omnis abundans!

Which may thus be engliſh'd.

Fire univerſal nature traverſes.
It makes the thunderbolt in tumid clouds:
In dire Vulcano's penetrates the earth:
And ſends the boiling water from its ſprings.
In hardeſt flint, and ſofteſt wood it dwells:
Which by colliſion ſhows itſelf in flame.
With fire ſo pregnant is all nature found!

13ly, The great queſtion then with us, is how the ſurface of the earth is put into that vibratory

vibratory and electric ſtate, by heat and drineſs? we muſt needs acquit the internal of the earth from the charge of theſe ſuperficial concuſſions. How then is the ethereal fire crouded together, or excited, ſo as to cauſe them; ſeeing in our ordinary electrical experiments, we make uſe of friction?

But that friction alone does not excite electricity, we know from the obvious experiment of flint and ſteel, where the ſuddenneſs of the ſtroke, and hardneſs of the matter does it. Another method of exciting it, is the letting off a number of great guns, which ſo crouds the ethereal fire together, as to electrify glaſs windows; obſerv'd by my friend the reverend Dr. *Stephen Hales*. The *aurora borealis*, *auſtralis*, all kind of coruſcations, meteors, lightning, thunder, fire-balls are the effects, and may reciprocally be the cauſe of electricity; but how in particular we know not. Come we to the animal world, we muſt needs aſſert, that all motion voluntary, involuntary, generation, even life itſelf: all the operations of the vegetable kingdom, and an infinity more of nature's works, are owing to the activity of this electric fire, the very ſoul of the material world. And in my opinion, 'tis this alone, that ſolves the famous queſtion, ſo much agitated with the writers in medicin, about the heat of the blood. How theſe, how earthquakes are begun, propagated, we are yet to ſeek. We

We may readily enough preſume, that the contact between the electric, and the non-electric, which gives the ſnap, and the ſhock, muſt come from without, from the atmoſphere. Perhaps by ſome meteor that crouds the ethereal fire together: which then flies off with that immenſe force that cauſes the earthquake. In the point of contact on the earth's ſurface, the ſame thing is done, perhaps, another time, by a ſhower of rain. Our thoughts upon this matter muſt needs be as immature, as they are novel. But we may readily conclude, that tho' the original ſtroke comes from the atmoſphere, yet the atmoſphere has no further concern in it: no aereal power, or change therein, can propagate itſelf ſo inſtantaneouſly, over ſo vaſt a ſurface, as 4000 miles ſquare. Therefore the impetuous ruſhing noiſe in the air, accompanying the ſhock, is the effect, and not the cauſe. And all this is ſtrongly confirm'd by this obſervation, that the barometer and thermometer receiv'd no change upon the earthquakes.

But ſurely, there is not a heart of fleſh that is not affected with ſo ſtupendous a concuſſion! let a man eſtimate his own power, with that which cauſes an earthquake; and he will be perſuaded, that ſomewhat more than ordinary is intended by ſo rare and wonderful a motion. That great genius *Hippocrates*, makes the whole of the animal œconomy to be adminiſtred,

ſtred, by what we call nature. And nature alone, ſays he, ſuffices for all things, to animals: ſhe *knows* herſelf, and what is neceſſary for them. We muſt extend this thought to the inanimate world. And can we deny then, that he here means a conſcious and intelligent nature, that preſides over, and directs all things, moves the ethereal ſpirit or fire, that moves all things: a divine neceſſity, but a voluntary agent, who gives the commanding nod, to what we commonly call nature; the chief inſtrument in the moſt important operations of the vaſt machine, as well as in the ordinary ones, particularly the human one: adminiſtring the whole œconomy (as he ſays) without noiſe, unſeen, unfelt. And this leads us,

14ly, Laſtly, in regard to the ſpiritual uſe we ought to make of theſe extraordinary *phænomena*, or of our inquiries about them, I ſhall firſt obſerve, that we find abroad, ſeveral of theſe earthquakes this year have been very fatal. In the laſt we read of, at *Philippopoli* in *Thrace*, the whole city was deſtroyed, above 4000 inhabitants killed. At home, where above half a ſcore ſeparate concuſſions have been felt, there has not been one houſe thrown down, one life loſt. This ought to inſpire us with a very ſerious reflection about them; nor is it altogether unworthy of our remark, that they began with us in *London*, in *february* laſt: and after viſiting the circle of the globe, at preſent, end with us.

2dly,

2dly, We may obſerve, that if we did but read the works of *Hippocrates*, *Plato* and his followers; of *Tully*, *Galen*, and the like ethic writers of antiquity; whilſt we ſtudy, and try the affections of matter; we ſhould improve in philoſophy, properly ſpeaking: we ſhould lift up our minds from theſe earthly wonders, and diſcern the celeſtial admonitions, they preſent to us.

The original meaning of the word philoſophy, was rightly apply'd to moral wiſdom. We who have advanc'd both the natural, and moral, ſhould, as the ancients did, join them both together. By this means, we gather, the truth of the higheſt, and moſt excellent philoſophy, to be found in thoſe volumes of firſt antiquity, which we call ſacred: and which, 'tis our peculiar, and ineſtimable happineſs to poſſeſs. We ſhould adore that divine light, which they hold forth to us. Eſpecially in a country, where the principles of true religion are open, and undiſguiſed: where the eſtabliſh'd profeſſion of it is rational, noble and lovely: worthy of the moral governor of the world; fit for him to enjoin: for us to practiſe, with pleaſure and effect.

november 7, 1750.

W. STUKELEY.

Read at the Royal Society, *december* 6.

F I N I S.