the fineſt Injection; opening the Stomach and Inteſtines they contained a mucous Matter, the greateſt Part of which was Blood, and the fine *villous* Coat which is ſo viſible in theſe Animals was entirely deſtroyed. About an Hour before he was bit he had a plentiful Meal of coarſe Beef, of which there was not the leaſt Appearance. Opening the *Thorax*, the *Pleura* and other Membranes looked as if injected; the Heart was turgid with Blood, as were alſo its Veſſels. The Veſſels of the Membranes of the Brain made a moſt beautiful Figure from the Quantity of Blood contained in them, as did likewiſe the Blood-Veſſels of the Nerves; there was a ſmall Quantity of Water between the two Hemiſpheres. The Blood contained in the Heart and its Veſſels was an even Maſs about the Conſiſtence of Cream. The Cat had upon opening nearly the ſame Appearances, and lived about five Hours.

II. *A Letter from the Rev. Dr.* Samuel Clarke *to Mr.* Benjamin Hoadly, *F. R. S. occaſion'd by the preſent Controverſy among Mathematicians, concerning the Proportion of* Velocity *and* Force *in* Bodies in Motion.

SIR,

IT has often been obſerved *in general*, that *Learning* does not give Men *Underſtanding*; and that the abſurdeſt Things in the World have been aſſerted and maintained, by Perſons whoſe Education and Studies

dies ſhould ſeem to have furniſh'd them with the greateſt Extent of Science.

That Knowledge in many *Languages* and *Terms* of *Art*, and in the Hiſtory of *Opinions* and *Romantick Hypotheſes* of Philoſophers, ſhould ſometimes be of no Effect in correcting Mens *Judgment*, is not ſo much to be wonder'd at. But that in *Mathematicks* themſelves, which are a *real Science*, and founded in the *neceſſary Nature of Things*; men of very great Abilities in *abſtract* Computations, when they come to *apply* thoſe Computations to the *Nature of Things*, ſhould perſiſt in maintaining the moſt *palpable Abſurdities*, and in refuſing to ſee ſome of the moſt *evident and obvious Truths*; is very ſtrange.

An extraordinary Inſtance of this, we have had of late Years in very eminent Mathematicians, Mr. *Leibnitz*, Mr. *Herman*, Mr. *'sGraveſande*, and Mr. *Bernoulli*; who (in order to raiſe a *Duſt* of Oppoſition againſt Sir *Iſaac Newton*'s Philoſophy, the Glory of which is the *Application* of *abſtract Mathematicks* to the *real Phœnomena of Nature*,) have for ſome Years inſiſted with great Eagerneſs, upon a Principle which ſubverts all Science, and which may eaſily be made appear (even to an ordinary Capacity) to be contrary to the *neceſſary and eſſential Nature of Things*.

What they contend for, is, That the *Force* of any *Body in Motion*, is proportional, not to its *Velocity*, but to the *Square of its Velocity*.

The *Abſurdity* of which Notion, I ſhall firſt make appear, and then ſhew *what* it is that has led theſe Gentlemen into Errour.

In the Nature of Things, 'tis evident, every *Effect* muſt neceſſarily be *proportionate* to the Cauſe of that Effect;

Effect; that is, to the *Action* of the Cauſe, or the *Power exerted* at *the Time* when the Effect is produced. To ſuppoſe any *Effect* proportional to the *Square* or *Cube* of its *Cauſe*, is to ſuppoſe that an *Effect* ariſes *partly* from its *Cauſe*, and partly from * *Nothing*.

In a *Body in Motion*, there may be conſidered diſtinctly, the *Quantity of the Matter*, and the *Velocity of the Motion*. The *Force* ariſing from the *Quantity of the Matter* as its *Cauſe*, muſt neceſſarily be *proportional* to the *Quantity of the Matter*: And the *Force* ariſing from the *Velocity of the Motion* as its *Cauſe*, muſt neceſſarily be *proportional* to the *Velocity of the Motion*. The *whole Force* therefore ariſing from theſe *two Cauſes*, muſt neceſſarily be *proportional* to theſe *two Cauſes taken together*. And therefore in Bodies of *equal Bigneſs and Denſity*, or in *one and the ſame Body*, the *Quantity of Matter* continuing always the *ſame*, the *Force* muſt neceſſarily be always *proportional* to the *Velocity of the Motion*. If the *Force* were as the *Square* of the Velocity, all that *Part* of the *Force*, which was *above* the *Proportion* of the *Velocity*, would ariſe either out of *Nothing*, or (according to Mr. *Leibnitz*'s Philoſophy) out of ſome

* Which is juſt *like* the *Suppoſition* made by thoſe Mathematicians, who have taken it for granted, that $\frac{1}{0}$ is equal to *Infinite*; that is, that as 0 to 1, ſo 1 is to *Infinite*; that is, that *Infinite* multiplied by 0, is equal to 1, or an infinite Number of *Nothings* equal to *Something*; which is palpably *falſe*. The *true Proportion* is, not as 0 to 1, ſo 1 to *Infinite*; but as *an Infiniteſimal* is to 1, ſo is 1 to *Infinite*. And as the *Infiniteſimal of an Infiniteſimal* (that is, a ſecond Fluxion, or the *ſecond Power of Infiniteſimal*) is to 1, ſo is 1 to *Infinity of Infinites*, or the *ſecond Power of Infinite*; that is, (for Inſtance) 'tis as a *finite* [*phyſical*] *Line* to an *Infinite Surface*, or as a *finite* [*phyſical*] *Surface* to an *infinite Solid*. And as 0 (which is *beyond all Proportion lower* than the *Infinit'th Power of an Infiniteſimal*) is to 1, ſo is 1 to that which is *beyond all Proportion higher* than the *Infinit'th Power of Infinite*. Which clearly removes the Foundation of all the *ridiculous* Conſequences, which have been drawn from the Suppoſition of the fore-mention'd *falſe* Proportion.

living

living Soul eſſentially belonging to *every Particle of Matter.*

Whenever *any Effect* whatſoever, is in a *duplicate Proportion*, or as the *Square* of any *Cauſe*; 'tis always either becauſe there are *two Cauſes* acting at the *ſame Time*, or that *one and the ſame Cauſe* continues to act for a *double Quantity of Time.*

The *Reſiſtence* made to a Body moving in any *fluid Medium*, is in a *duplicate* Proportion to the *Velocity* of its Motion; becauſe, in Proportion to its *Velocity*, it is reſiſted by a *greater Number of Particles* in the ſame Time; and again, in Proportion to its *Velocity*, 'tis reſiſted by the *ſame Particles ſingly* with a *greater Force*, as being to be moved out of their Places with *greater Velocity.*

Light decreaſes in a *duplicate* Proportion of its Diſtance from the Sun; becauſe the Rays *divaricate* according to *two* Dimenſions; according to the Dimenſion *upwards* or *downwards*, and according to the Dimenſion *ſide-ways.* But according to the *third* Dimenſion *forwards* from the Sun, a Ray of Light undergoes no Alteration; becauſe the Particles, of which it conſiſts, being emitted all of them with an equal Velocity, continue every where at an equal Diſtance from each other.

One and the *ſame* Cauſe, acting in a *double* Quantity of Time, produces the *ſame* Effect, as *two* equal Cauſes acting in a *ſingle* Quantity of Time. One and the ſame *Force*, in *two* Parts of Time, will cauſe a Body in Motion to deſcribe the *ſame Space*, as *double the Force* would do in *one* Part of Time. The *Space deſcribed* therefore by a *Body in Motion*, is not as the *Force*; but as the *Force* and the *Time* taken *together.*

A Body, with any the *leaſt aſſignable Force*, will move through *infinite Space*, if it meets with *no* Reſiſtence, in an *infinite Time*. And in Spaces where there is an *uniform* Reſiſtence to Motion, the *Space deſcribed* before the Motion ceaſes, muſt needs be as the *Force* and as the *Time* together: Becauſe a *double Force* will carry a Body *twice as far* in the *ſame Time*, and will alſo cauſe the Motion to be *twice as long Time* in *deſtroying* by an uniform Reſiſtence. The *Space deſcribed* therefore before the Motion ceaſes, is in this Caſe demonſtrably as the *Square of the Force*. A Body *thrown upwards* with *double Force*, will be carried *four Times* as high, before its Motion be ſtopp'd by the uniform Reſiſtence of Gravity; becauſe the *double Force* will carry it *twice as high* in the *ſame Time*, and moreover require *twice the Time* for the uniform Reſiſtence to deſtroy the Motion. The Caſe is the ſame in *accelerated* Motion; in Bodies *accelerated* by a Succeſſion of elaſtick Impreſſions, or *falling* with a Motion accelerated by the uniform Power of Gravity, or by any other uniform Power whatſoever. The *Space deſcribed* muſt needs be as the *Force*, and as the *Time wherein* the Force operates.

What I have thus demonſtrated concerning *any Force*, conſidered as the *Cauſe* producing an Effect; and concerning the *Time*, during which the Force operates; is on all Hands acknowledged to be true concerning *Velocity*. And therefore *Velocity* and *Force*, in this Caſe, are one and the ſame Thing. So that to affirm *Force* to be as the *Square* of the *Velocity*, is to affirm that the Force is *equal* to the *Square* of *it ſelf*.

Now from hence appears very clearly the *Ground* of the *Errour* theſe Gentlemen have fallen into, and

of their *Miſapplication* of the Experiments they build upon.

The *Effect* of a *Force* impreſs'd on a moveable Body, is the *Motion* of that Body from one Place to another. Now foraſmuch as the *Effect* cannot but be proportional to its *Cauſe*, hence Mr. *Leibnitz* (whom the other Gentlemen have follow'd) contends that the *Space deſcrib'd* by a Body in falling, is proportional to the *Force* by which it is impell'd during its Fall; and that the *Force* acquir'd by a Body in falling, is proportional to *the Space it has deſcribed* in its Fall. Which *Space* being agreed to be as the *Square of the Velocity* (as being proportional to the *Velocity* and to the *Time* taken *together*) hence they infer that the *Force* likewiſe is as the *Square of the Velocity*.

But from what has been ſaid, 'tis plain, that the *Space deſcribed* in theſe and all other the like Caſes, is not as the *Force* only, but as the *Force* and as the *Time wherein* the Force acts; that is to ſay, as the *Square of the Force*. For the *Cauſe* of the Quantity of the *Space deſcribed*, is not barely *the Quantity of the Force*, but alſo the *Continuance of the Time* wherein the Force acts. The *Force* therefore and the *Time* taken *together*, being neceſſarily as the *Space deſcribed*; as the *Velocity* and the *Time* taken *together*, are on all Hands acknowledg'd to be; it follows that the *Velocity* and the *Force* are equal, and not the *Force* as the *Square of the Velocity*.

When two *unequal* Bodies faſtened at the Ends of the *Arms* of a Balance of *unequal Length*, counterpoiſe each other, and vibrate in *equal Times*; as they muſt neceſſarily do, being *faſtened* to the Arms of the *ſame* Balance: which is an Obſervation Mr. *Leibnitz* lays great Streſs upon: In *That* Caſe indeed the *Forces* will

will be as the *Spaces deſcribed.* But not therefore as the *Squares of the Velocities.* For in *That* Caſe, the *Velocities themſelves* are as the *Spaces deſcribed,* becauſe the *Times* are equal.

When a Body projected with a *double Velocity*, enters *deeper* into *Snow* or *ſoft Clay*, or into a Heap of *ſpringy* or *elaſtick* Parts, than in Proportion to its *Velocity*; 'tis not becauſe the *Force* is more than proportional to the *Velocity*; but becauſe the *Depth* it penetrates into a ſoft Medium, ariſes partly from the *Degree* of the Force or Velocity, and partly from the *Time wherein* the Force operates before it be ſpent.

In the Colliſion of *hard* Bodies, 'tis (I think) agreed on all Hands, that 'tis *demonſtrated* by *Reaſon*, and confirmed by *Experience*; that when a perfectly hard Ball, moved with *whatever* Degree of *Velocity*, ſtrikes full upon another hard Ball, equal in Bigneſs and Weight, and without any Motion in it; if the Balls be *unelaſtick*, they will both go on together the ſame Way, dividing the Motion equally between them, with *half the Velocity* the firſt Ball had originally: But if they be perfectly *elaſtick*, the moving Ball will communicate its whole *Motion and Velocity* to the quieſcent Ball, and it ſelf *lie ſtill* in the others Place. Were it true now, that the *Force* of the *moving Ball* was as the *Square of its Velocity*; theſe Experiments would then ſhew (which is infinitely abſurd) that the *Force* or *vis inertiæ* in the *quieſcent* Ball, the *dead* Force, was always proportional to the *Square of the Velocity* (which theſe Gentlemen affect fantaſtically to call the *living* Force) of the *moving* Ball, whatever its Velocity were. Or the *Force* in *Both* might juſt as reaſonably be ſuppoſed to be as the *Cube*, or the *quadrato-quadrate*, or any *other Power* of the Velocity of the *moving* Ball. Which is turning the *Nature*

of Things into Ridicule. Mr. *Leibnitz*, in ſome Letters which he wrote into *England*, intimated that he had a Proſpect of a *perpetual Motion*, founded on the Notion of a *Vital Principle*, or *active Power* in *Matter*. But from the Experiments now mentioned, 'tis evident that if the *Force* of Bodies in Motion could be exalted even to the *infinit'th Power* of their *Velocity*; yet ſince, to anſwer the Phœnomena of Nature with Regard to *Action* and *Re-action*, the ſame *Force* muſt neceſſarily be allowed to all *quieſcent* Bodies likewiſe; it could be of *No Effect*.

III. *Aſtronomical Obſervations made at* Vera Cruz, *by Mr.* Joſeph Harris. *Reviſed and communicated by* Edm. Halley, L. L. D. Aſtron. Reg. & R. S. S.

THE Latitude of this Place I found (by ſeveral diſtant Obſervations made by a Quadrant of four Feet Radius) to be 19° 12′ N.

On *March* 11, 1727. *O. S.* there happen'd here a conſiderable Eclipſe of the Sun, the greateſt Obſcuration being about 10½ Digits; and having that Morning carefully adjuſted the Pendulum Clock, and fixed a Teleſcope to the Index of the foreſaid Quadrant, I obſerved it to begin in or about the *S. E.* by *S.* Part of the Sun's Disk at 49½ Minutes after Noon apparent Time; the Altitude of the Sun's Center then was 67° 53′.

We could not determine exactly the Middle of this Eclipſe, but as near as we could judge, it happen'd about $2^h\ 30^m$ P. M.

The