

**A  
description  
concerning  
such mechanism  
as will afford a nice, or  
true  
mensuration of time;**

together with  
some account  
of the  
attempts for the discovery  
of the  
longitude by the moon

as also  
an account  
of the  
discovery  
of the  
scale of musick

by John Harrison

inventer of the time-keeper for the longitude at sea



Of the nature of a pendulum, as primarily implying in itself; and secondarily as when according to any particular manner (good or bad) in which it may be applied to the draught of the wheels of a clock &c.

As first, or rather as here at the first (viz. as without the taking any notice of the great or chief matter, viz. of what pertains to different vibrations, or rather, as more properly speaking, of what advantage pertains to, or accrues, from the largeness of vibration) the bare length of a pendulum can be no otherwise rightly considered or esteemed, but as only to what it bears, or may (as according to the common application) bear in proportion to the length of the pallets, and as together with such improper powers or circumstances thereunto belonging, or may, as farther thereunto belong; *i.e.* in other words (and as still in the first place) to the equivalent distance from its centre of motion, to where the pallets, according to their construction, and as may, or will continually happen with their different states of the oil as in the common way touch or are applied to the wheel; nay, sometimes some men, as being quite ignorant in what I am here about to shew or speak of, and as when they are about to do something very extraordinary as they imagine, do render the matter as still worse than so, yea even by far; whenas the which, my good friend Mr Graham ordered the matter (viz. as in what are now called astronomical clocks; notwithstanding their being still, as an uncertain sort of regulators, or defective time-keepers) the pendulum, as with respect to the length of the pallets, and as here in the first place to be notified, being no more than as about  $14\frac{1}{2}$  to 1, so the which in effect is no better or can in power (as even in this point the length) be no better than as a long pendulum rendered a short one. And whenas farther, it is withal to be observed; viz. as according to Mr Graham's method, (and as even already in some measure intimated) that, as in the time in which his pendulum wheel is acting, so as whereby to maintain the motion, or as here to the purpose more properly speaking, the poor, little or feeble motion of his pendulum, that as I say, as the same is so to be let, viz. through or from the great sloping of the pallets or manner of 'scaping, so as to jam, wedge, push or press forward, viz. as with a much quicker motion, nay as thence to be suffered even to pass through twice so much space as in during that space of time the pallets, or each pallet has to recede or move from it, (viz. from the wheel or as in perpendiculars thereto) and as when the same (or as notwithstanding the same) must, as moreover be in effect as still a great shortening or disadvantage to the power or regulation of the pendulum; for upon a right consideration; as taken in with the other, (viz. the length of the pallets, or the distance of their action from their respective center, or that of the pendulum's suspension) the pendulum must, as thence in the whole, be rendered as a very short one indeed, yea so short (as with respect to the same construction of the pallets) as hardly to be esteemed so much as 10 to 1; nay, (from what has been shewn) it cannot be said to be amiss, if I say, but as  $7\frac{1}{4}$  to 1; a very improper proceeding sure! <sup>1</sup> And that, as not only with

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<sup>1</sup> And as here, by the by, a very bad example for church and turret clocks; for in them (in this disposition of the pallets, or dead-beat way, as according to Mr Graham) even the different weight of the rope, viz. betwixt the weight being up and almost down, will greatly affect the vibrations of the pendulum; as also the same in the

regard to the inconstant action, dominion, or power of the wheel or wheels, by the said pallats to the pendulum, but as more especially, or as rather on the other hand, by or from the ill consequence of such an improper construction of the pallats; viz. as with regard to their communicating the natural stability or regularity of the pendulum to the clock; *i.e.* in the whole as in other words, and as without any provision to the contrary, viz. so as that no such uncertainty as might ever happen, and as in the first or chief place from the said pallats themselves, or the oil upon them, and that as at their vast length from the center of motion of the pendulum as above; neither, as secondly, from any difference in the draught of the wheels of the clock, as from the said oil at their pevents, nor as elsewhere, or otherwise to be occasioned, and as to be by such the same pallats conveyed to, or impressed upon the pendulum, should ever be able to prevent or affect the regularity of the same; whenas there is nothing at all towards these in the matter! but only as it were, on the contrary, the bad effects or embarrassment (and in a bad manner) of more or less uncertain friction! or of such differences as may or will continually happen therein! viz. such as must the most especially have a bad influence upon small vibrations, as being so nonsensically coincident in the pallats, as at so remote, or as even at so rudely remote a distance from the center of motion of the pendulum! But as notwithstanding, the learned part of the world (through Mr Graham) is become so stupidly confident in the nonsense, as hardly to be persuaded that any thing else can ever be better; they indeed, (*viz.* the public) not having as yet (as I have) any experience to the contrary; nor hitherto has right steps been taken ever for them to have it; but that they might still keep in the dark, or at least in a mist as they have done; whenas, it has ever been surprising to me, how such stupidity could take place and spread itself in the world; for the first time I saw Mr Graham, and he shewed it me, I thought, that either he must be out of his senses, or I must be so! Now, as touching the matter, or first matter in mine, viz. the length of the pendulum, as with respect to the distance from its center of motion, to where the force of the wheels is applied, is about in proportion as 100 to 1, and as without any such wedge-like thrusting as spoken of above, and as withal with no different clamminess of oil, there not being, from the construction and material of my pallats, any oil required, but as on the other hand, and as implying at a small distance from the center of motion of the pendulum, and that besides such other virtue or virtues as below, the friction at the said pallats to be so far diminished by the contrivance as not to come to the 100th part of what is in the common way, no, not when in that way (as meaning the same in Mr Graham's way) the oil is in its greatest state of fluidity; but, indeed, as with respect to this latter article, viz. the very small quantity of friction at the pallats, it in itself may be esteemed, as with respect to the length of the pendulum, to where its effect is from the center of motion of the pendulum, to be as about 44 to 1, but still, as whence from its smallness, as just above spoken of, it must be rendered so  
(..continued)

discharging of the striking part. Nay, Mr Graham himself did not think it to be proper, that one of his clocks should so much as have a day of the month to shift, (and well he might not) whenas, to a right application of the pendulum, (and in supposing, as in common, all the wheels concerned) that must be as nothing, was it to go harder than what it needs to do; and as with regard to church and turret clocks, there is room for great improvement, viz. as in comparison to what is hitherto done.

as to become in effect even as quite insensible, immaterial or nothing, nay, as not in the whole, when rightly considered, to be worth any notifying at all; and withal, as the pivets of the arbor of the pallets and crouch are made of brass, and are only as edges of a very acute angle, and move in polished notches cut in glass, so the friction there must also be insensible; for, if for an example in the point, the said crouch (or communicator of the force of the wheel, by the pallets to the pendulum, and as for this experiment, without the pendulum upon a table) be set to vibrate only so far, as not to cause the pallets to touch or be concerned with the wheel, it will be 10 minutes before it comes to rest, the which the air (at the rate it will vibrate with its returns, and has so light a matter) may be supposed sufficient in that space of time to occasion. But it is alledged, in Mr Graham's case (viz. in the wheels acting on the pendulum) at so far a distance from the center of motion of the pendulum) that a much less force, or a very small force from the wheel, will keep the pendulum in motion; an idle way, indeed, to consider the thing! since (and even as already implied) it is not properly (or singularly) force from the wheel that can occasion a variation in the motion of the pendulum, for the bigger the force the wheel can well or rightly be permitted to have, the more constant or certain that force will be to itself; so from the point in hand, or from so far as belongs to it, <sup>2</sup> any variation in the mensuration of time, must, as above, be from the different states of the oil, and as chiefly at the pallets, viz. as with regard to the smallness of the force from the wheel (since differences therein will be the greater in proportion) and as when the same is withal to be taken or considered at the greatness of the distance from the center of motion of the pendulum, to where it is (as with such differences) applied by the pallets thereto, and as still together with the coherent, or rather coincident smallness, weakness, or feebleness in the vibration, there must I say, variations arise from the whole; for, as farther, was it to be better for a small force from the wheel to maintain the motion of the pendulum, it would then be the best for the wheel to act at such a length of pallets as to be equivalent to that of the pendulum, for then (and as withal to be with or for such an insignificant vibration, as could but hardly be said to be a vibration, but still such as must be coincident in the matter) a very minutely force would do; but, I pray, to what purpose? for where then would be the property or power of a pendulum at all, viz. as with regard to such instability as must or would attend such a force, (could, as most unreasonably, the same be always supposed to exist) and as even in supposing the bob to be immensely heavy? (and yet to this is Mr Graham's product is pretty much a kin, or at least bears thereunto too great a proportion!) And as therefore from whence, as by way of corollary, and as a tenor to be extended to all that can be said of this point in general, that through the pendulum wheel's passing by any means, as (if you please) in unregarded proportion, or as in any proportion through too much space in a second, (or piece of a second) and the pendulum through too little, (viz. in each of its swings) must give the wheel and pallets, with what may attend them, too much mastership over, or

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<sup>2</sup> A firm suspension of the pendulum to be, as in the first place, made sure of, viz. from a firm wall, as not having, or to have any dependance from the clock, the clock-case, or any wainscot; for as without that, and as hitherto in common, all must be no better than chance, as with respect to any true performance of a clock.

bad effect upon the pendulum; insomuch, that the different states of the oil, and as chiefly at the pallats, and as together, and as partly thereby occasioned from the different states of the air, both must and will occasion considerable variations in the motion of the clock; for as when from either of these, or any cause whatever, friction at the pallats is increased, a touch of fresh oil thereunto applied, (viz. at one or two of the teeth of the pendulum-wheel) I mean, whether in Mr Graham's way, as now very common, or whether in the other, as yet, or still the more common, will occasion a different motion of the pendulum; but as in Mr Graham's way, through the very great or improper sloping, or as it were wedge-like thrusting or jamming scapement of the pallats, viz. so as whereby to suffer the wheel to move or pass much faster forward, than each pallat as at right angles has to recede from it, and at so great a distance from the center of motion of the pendulum, and as together with the coherent weakness or feebleness of the motion thereof, and that as through the smallness of its vibration or arch it describes, (O fie!) and as most especially so, when the clock or its oil grows foul, the touch of oil (as here above mentioned) will occasion the pendulum to fetch a greater arch, and the clock thereby to go the faster, (O fie, I say!) as was (according to my reason for the matter) occasionally experienced and testified by Dr. Bradley, for from which he found (as at the juncture, season, or as upon the occasion he did it) a variation or alteration in its motion of about 2 seconds a day faster; and had the pevetts of the wheels been also (as at the same time) touched with oil, it would doubtless then have gone faster still; <sup>3</sup> whenas the same touch or touches of oil, as upon occasion applied to the other way, viz. where the vibrations are larger, will (as above) make the pendulum to fetch the farther, but the clock thereby to go the slower, the which must be, nay, is in this point the better, because as here (or as in this latter case) it is according to the nature of the pendulum whenas it is plain that as in the other, it proves the contrivance to be even as quite contradictory to it, meer corruption! yea, as notwithstanding any such massiness as may or ever can be in the bob, viz. as with respect to the force that is to maintain the motion! <sup>4</sup>

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<sup>3</sup> Now it is to be notified, that as Mr Graham had not the redoublings of his brass and steel wires (viz; as in my invention of the compound pendulum) so long by a good deal, no, not even by 2 inches or more, than as what I had found to be required therein, (for, as otherwise, my clock would go too slow in summer) whence it must be plain, or as a proof of the matter, that from the extravagant length of pallats he used, viz. as acting upon the pendulum at so great a distance from the center of motion of the pendulum, and as together with their powerful sloping, pushing, jamming or wedging; and when, as farther, in or for such little or feeble vibrations thereof, as thence to be described, must have as generally speaking when warm, a greater power through glibness, to hasten such the said feeble or small vibrations of the pendulum, (the pendulum being then, had matters been right, as here above to be understood, too long) than as when from that, their improper principles, to be attended with clamminess when cold (I say this must be the case, as generally speaking) and to which the result of Dr. Bradley's touching his pendulum-wheel with oil, agrees exactly well; it being to be understood, viz. from what is here above as first advanced in this note, that the shorter the redoublings of the wires, the longer the pendulum when warm.

<sup>4</sup> And upon this head it may, or is to be notified, that some have spoke of how long a pendulum will vibrate when exempt from the wheels of a clock, as taking no notice of how long it will vibrate when at a clock, and as when set at so low a vibration, as not to suffer the pallats to interchange, but as when the force or action of the pendulum-wheel is to lean against one of the pallats, or long pallats, for during the time of that experiment; neither any notice of the most chief, viz. of the difference there will be (in that case) betwixt when the pallats and wheel are clean and new oiled, to what there will be when foul.

consequently, was there no other matter or matters in the affair but this, whenas, to come to the truth, or to a continuing truth, there are other things besides this, and they of very great moment; but I say, as in consequence to the matter here, and as with the pallats shorter, and the wheel with a draught suitably bigger, a properness, viz. as when, as thence from experience in the largeness of the pendulum's vibrations, and as with a proper recoiling of the wheel instead of lying dead ought to have been acquired, and not to have let or occasioned so many things to be made as upon so very improper, or as it were, degenerated principle; <sup>5</sup>

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<sup>5</sup> Now it is, or must be very proper, that this should be put into writing, lest at any time, or as still hereafter, even so much as 2 seconds a day, as in Mr Graham's clocks, at distant times may or will sometimes, or rather often times happen, from natural causes, (*viz. as in supposing the nut of the pendulum screw to be let to remain untouched, or unhitched, after it is once supposed, or the clock supposed, or to be taken to be as truly adjusted*) I say it must be proper, lest such a matter should never be thought to be rightly accounted for, as here above I am very sure it is; but had he, and as even with the same preposterous length of pallats he used, so ordered the matter, as that the sloping of said pallats, viz. as in the manner he did it, (and as intimated, at such an enormous, extravagant, or unreasonable distance from the center of motion of the pendulum) was not to have been suffered to begin its action upon the pendulum (*viz. as from the wheel*) till some time after, or past the middle of each vibration, viz. so much after as perhaps about one 6th part of such a vibration, (or of such his small vibration) or perhaps (as differences must continually happen therein) somewhat more or less, but as best to have been acquired from experience, viz. so far as that might have been able to do it, as not meaning as thence, of from its nature, ever in anywise to have been done to perfection, and as when meaning withal, the pendulum to be firmly suspended with brass or iron from the wall; for, as without which, it could but be as a very short or deficient progress; but as then, viz. as from a more proper beginning of the action of the pallats upon the pendulum, the case as much for the better might have been different, and that, not only with respect to the touch of oil at the pallats, (or, as above, pendulum-wheel) but as also with respect to a different force from the wheels; for here I must let it be understood, that the later any help or force in any vibration is given, (*viz. for the maintenances thereof*) the longer time it will take up in its being performed; and as thence withal, (or as in consequence) the greater that force (or rather pop, as I may here, viz. as in Mr Graham's case, term it) the longer each vibration will, or would as thence still be, viz. as jointly from its lateness, or, as mathematically speaking, the more time each must as still take up in its being performed; consequently glibness here might not occasion the clock to go faster, but might as easily make it go slower, the matter (as under such circumstances as above shewn) not being as a thing exactly to be nicked: but here as withal, this must be with supposing the contrivance to admit of such lateness of the pop, whenas it could not well do that, because of such length of weakness that would as thence be required at the ends or extremities of the teeth of the pendulum-wheel; no, neither would that be all, but that the clock would as thence, viz. from the lateness of the pop, and as with the littleness of the vibration, and instability of the force or draught of the pendulum-wheel, viz. as from its smallness, be sooner in danger of standing; therefore, in the whole, a very deficient proceeding; and one would even wonder, that among all our mathematicians and geometricians, that any thing material should, for so long a time, or for any length of time, be pretended by it. I say, it ought at least, as with regard to their honour, to be taken as a wonder that they have not as yet seen this, viz. the nonsense or over-sight in the matter, and that as in the following light, where even Dr. Bradley's touch of oil, as under the improper circumstances as above shewn, (*viz. of so small or feeble a vibration, and as to be maintained by a sudden, but as still with respect to the matter, by such a powerful impulse or pop, viz. at so great a distance from the center of motion of the pendulum*) has not as yet fairly unveiled to them the weakness of the matter, must (I say) be short indeed, viz. so that instead of a lying dead, there ought (as in the improper case) to be or to have been a little hooking, or, as more properly speaking, a little convexical slanting or bowing in that same part of the pallats the other way, in order (as in some measure) towards helping up the last part of each vibration of the pendulum, viz. in its ascents, and the same to hinder it in the beginning of each of its descents, (the teeth of the wheel being so to be curved forward as to admit of that, - bad to execute) but from whence in the whole, (though undiscovered by such learned men as above) the clock to have gone somewhat slower, (but that to be, or to have been taken in, in the common adjusting) and not, as thence, faster by a touch of oil; but this indeed where, or as together with so much friction or difference therein, as here above attending, would be a very uncertain matter, viz. in what portion it might want to be done, or could be rightly done; and the redoubling of the wires (*viz. the provision for heat and cold*) would require to be longer as also the same from the lateness of the pop,

but still, though it might have come pretty much nearer, as according to what I have illustrated, viz. as thence nearer to the truth in general, yet still, as I may make bold to say, that if any oil be required at the pallats, (viz. in such pallats, case or cases, as I am here speaking of) it will but hardly let the clock to go, as strictly speaking, two days alike, viz. as when the state of the weather is pretty much varying; nay, neither as in Mr Graham's way, nor as in the other more common, even whether any oil was required at the pallats or not, as the weather is variable, it or they would not continue as quite the same, viz. as with respect to their action upon the pendulum, and certainly Mr Graham's could not in that case have the odds of the other, consequently the wires, or the compound of the pendulum for heat and cold, never as thence to be truly adjusted, viz. as by or from any provision whatever thereto, and so, as even in consequence of that, (was there nothing else) never to be rightly fit for astronomy. But as here to desist from treating of such pallats as those, viz. as where oil must be concerned, and not as only so, but as also (as hath been shewn) from such imperfections as otherwise attending, (and as from Mr Graham received in the world) it is to be understood as followeth, viz. that in my contrivance or construction of the pallats, no oiling (at the same) could ever occasion the vibrations of the pendulum to alter, but as on the other hand, would occasion such mischief at the said pallats, as not to suffer them to interchange at all, consequently the clock not to go at all; but, as without that, they will as not only at all times go, (viz. as in all seasons) but that with so great a freedom from friction, as whence with such their other properties or qualifications as of which hereafter, (and as being withal upon a far more proper foundation, viz. as touching the whole clock than any heretofore) so that indeed a very great truth, viz. as to less than a second in a month, is as thence ascertained; and it is certain that my next clock, when finished, properly set up, and duly adjusted, will come to the truth nearer still. And now if this, or any part of this, should be thought strange, as touching my friend Mr Graham's proceedings, then (as in some measure parallel thereto) I may ask the reason, why, out of so many hundreds of musicians as there are, and have been in the world, (and some of them also mathematicians) why, I say, that no one had ever as yet before discovered the true or real scale of music, or its foundation? as of which hereafter; but towards the matter, as they thought it to be, (or that it must be) was always an acting in some measure contrary, and that as not to be taken in a small degree, contrary, I say, to the nature of the thing, viz. in tuning the organ, harpsichord, and spinett! Nay, the great Mr Handel had his organ, &c. so tuned! But as notwithstanding, if it should still be thought strange as with respect to my worthy friend Mr Graham, I will here certify, and that was it upon oath, (as according to Lord Morton's proceedings) that I neither have said, nor shall express, any thing more than what, or as according to the tenor of which I expressed by times to Mr Graham himself, face to face, as I may say, for we reasoned the cases, or upon the principles, more than once; nay once, and that in a very extraordinary manner, was at the very  
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as here above, as may be gathered from what I have shewn in the note last above. But now as hence, or as from these affirmative supposals, (and that as the chief matter aimed at) is fairly shewn the improperness, or rather the impracticability, of a small vibration, viz. as for any certain good or truth; as the same of which I have as otherwise shewn, and shall as hereafter farther shew.

first time I saw him, and our reasoning, or as it were sometimes debating, (but still, as the main, understanding one another very well) then held from about ten o'clock in the forenoon, till about eight at night, the time which dinner took up included, for he invited me to stay to dine, &c. Now it is to be understood, that I had along with me (as affording the principles upon which we reasoned) the descriptions, with some drawings of the principal parts of the pendulum-clock which I had made, and as also of them of my then intended timekeeper for the longitude at sea. But here it must be highly worth remarking, that I at first made application to Dr. Halley, and as he had long been observing for the longitude by the moon, and as then becoming quite tired of it, or thoroughly satisfied, as touching the impossibility of its ever doing any certain good (but not then so to be let known to me, but was afterwards told it me by Mr Graham) received me the better; and in his finding what I came about to be as principally touching a true mensuration of time, viz. for that purpose of longitude; but as previous thereto, viz. as in his findings my dealings with the pendulum for a true mensuration of time, to be very much contrary to Mr Graham's thoughts of, or proceedings in the matter, advised me therefore to go to Mr Graham, but that advice went hard with me, for I thought it as a step very improper to be taken; but he told me, that in the way in which I was, viz. as by machinery (for the longitude) more than astronomy, that I should certainly be sent to Mr Graham, and therefore advised me to go without any farther to do; certifying me also, that Mr Graham was a very honest man, and would do me no harm, viz. as by pirating any thing from me, but that on the contrary, would certainly do me good if it was in his power; but withal cautioned me how to begin with Mr Graham, viz. so as in as few words as possible, to let him to understand, that I had indeed something worthy notice to communicate to him; but as notwithstanding that piece of advice, and my doing my best pursuant thereto, Mr Graham began, as I thought it, very roughly with me, and the which had like to have occasioned me to become rough too; but, however we got the ice broke, the which would not bear, and the passage over was as I have shewn, and indeed he became as at last vastly surprised at the thoughts or methods I had taken, or had found occasion to take, and as thence found reason enough to believe that my clock might go to a second a month, and that as in consequence to be, as in the first place, of great service in the adjusting a timekeeper for the longitude; and indeed, as according to Dr. Halley, Mr Graham proved a very great friend to me, viz. not only as by his assistance at the Board of Longitude, &c. but also in his so willingly lending me money, as without any security or interest, and by the which, together with what other gentlemen were pleased to give me, I was encouraged; as Charles Stanhope Esq; £80 (viz. £20 a time, at four different times at which he came to see me, with my good and worthy friend Mr Folkes along with him) the East India Company £100 and several others who worthily contributed to my expence, and still Mr Graham among the rest, nay, as at one time Mr Graham, Mr Folkes, Dr. Heberden, and Mr Short each 10 guineas, Lord Barrington 5, and 10 from an unknown hand. Now by these, with several others, (nay indeed a many others) I was encouraged, for otherwise, as from the encouragement of the public alone, I could never have gone through what I did go, nor consequently ever have made a completion of the matter. So now after this (as in some measure historical piece) to proceed.

And first, as letting the proper circumstances, quality, or efficacy of the pallats for a pendulum as above treated of, and as when together with such their other unparallelled properties as below, to be fairly or rightly considered, it must as in consequence, and that as here in the first place follow, (viz. as from the construction of the said pallats, and distance inversely from the center of motion of the pendulum, to where the force or draught of the pendulum-wheel is by them communicated to the said pendulum) that the power a pendulum must as thence have, so as whereby to regulate a clock, must, I say, as in supposing the bob of a certain weight, be about as the square of the arch it describes; therefore, as by corollary, it must then follow, that if a bob of 3 pounds weight be sufficient to regulate a clock, when the pendulum describes an arch of 12 degrees, 48 pounds must be required to do the same execution, or to be the same in power, whereby to regulate, if the pendulum describes but 3 degrees; but it is to be remembered, that this must be as already implied, viz. as in supposing a proper construction, or due qualification of pallats, still, or as in both cases to be applied, whenas the which, to so small a vibration as the latter, could not be, nor does it want to be, neither was the which in either, or as in any case, ever done before mine, nor as yet right by any but me; no model thereof, draught, or sufficient instruction being as yet communicated to the world; and as without which, although as it were my natural road, would still prove a very tedious matter to others, it being (as it were) so very much out of their beaten path; as indeed the execution of which (with what must at first pertain thereto, and as without instruction) would, or must have been no easy matter to Mr Graham, was he to have set about it, or was his integrity so to have permitted him; but still, as with respect to the matter, Mr Graham said to several gentlemen, that for my improvement in clock-work, I deserved £20000 - was no longitude to be concerned, and that because, as he found good reason to think, viz. that such perfection by any other or others would never have been, there being indeed a great deal of reason, viz. as touching the whole clock, to suppose as he did on the contrary; but however, the way or ways they are in will, or may do for common uses, but can never do rightly for astronomy.

And now, as granting a large vibration to be necessary, it farther remains to be understood, that a pendulum cannot still truly or strictly regulate a clock, viz. to any continuing perfection, nor could any thing of or as in lieu of what is called a cycloid, occasion it so to do; unless, as in the first place, the force from the wheel whereby its motion is to be maintained against the air's resistance, be the very same, or can prove the very same as with respect to it in the whole, as that its vibrations, or (as here to speak more closely to my construction of the pallats) any two of its vibrations as next in succession, <sup>6</sup> may be performed exactly, or, as it were mathematically speaking, in the same time as if at the same mathematical length it went, or as might be supposed it would go by itself (viz. as without any

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<sup>6</sup> For it may be notified, as just here hinted, that the actions of each pallat are not equally the same upon the pendulum, but not so, as to be easily perceived to be otherwise, viz. as in looking at the clock, or the seconds in motion, although in this most highly material circumstance, or construction of the pallats, pretty much different, but still, not so to be taken (viz. as with respect to the essential point here in hand) as to be any the least worse for the same, but as that the action of one with that of the other, are quite right, for or to the purpose, as farther of which below.

force from the wheels of a clock) in vacuo; or at the least as nearly thereto as possible in the case, or as to be conceived of the matter, and that as with still retaining the above-mentioned qualities of the pallats, for any device in the same to render it; as the which, from due contemplation and experience, I perfected. For, as to this weighty article, it is to be understood, viz. from the construction of my pallats, (as intimated above) that the force of my pendulum-wheel is so disposed of, as that, whether the said force at any time becomes somewhat greater or less in itself, or that the air at any time gives somewhat more or less resistance to the pendulum, or both, (see the note) <sup>7</sup> it is the same to it as here above required, (but

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<sup>7</sup> Now this highly material matter is from the wheel's acting (by my contrivance of the pallats) more weakly upon the pendulum in each or every one of its descents, viz. from the extremity of each vibration, (and there, as at the first, the weakest of all) to the bottom or middle of each, and then (as still continuing) more and more strongly upon the pendulum in each of its ascents, and the strongest of all just before the interchanging of the pallats, and the which interchanging not being, or to be far from the extremity of each vibration, and in which little, or as it were overplus part, a necessary recoiling of the wheel to be, viz. as not only for the interchanging of the pallats, the which, as according to my construction of the same is required, but as withal to have in some measure to do with the effect of a cycloid, but not to be the whole concern in that matter; the pendulum withal requiring to be (viz. as from my contrivance of its combination of brass and steel wires) rather, as mathematically speaking, shorter when warm than when cold. But as here, to come a little nearer in this material point, let, as I order the matter, the force (from the wheel) upon the pendulum, as just before the interchanging of the pallats, to be as by or from them the said pallats supposed or taken as 3 then, as just after their interchanging (and the force to contrary direction, it must but be about as 2, that is, it must be so ordered, (as may hereafter be observed by the drawing) viz. as that it be so by the taking, or supposing for the purpose, a mean betwixt the actions of each pallat, and withal, as farther to the purpose, that, as in the little recoiling of the wheel, to become less and less to the extremity of each vibration, but as whence, or as still on course, the greater at any time the whole vibration may be, of more efficacy the same small force (and still as it were in the little recoiling) must from its quantity or duration prove, and that in such small measure as required; the resters of the pallats (viz. their composers to relative rest) having withal for the better a little to do in the matter, and the which is still from, or as with respect to the length or shortness of the time (though always to be esteemed as but little) that is to be occupied in the recoiling; it being to be understood, that was the force of the said wheel, or pendulum-wheel, to be disposed of uniformly upon the pendulum, throughout the whole of each vibration, that then the bigger that force, and as with some recoiling of the wheel, the more it must tend towards occasioning a greater vibration, or somewhat a greater vibration of the pendulum to be the sooner performed; but that is not the case in what is, as just here above shewn, but, to the purpose, is otherwise to be taken or considered; as that the bigger the force towards the latter end of any vibration, viz. as in comparison to what it may be at the fore end or beginning, and as in supposing without a recoil of the wheel, the slower the vibration must be, or the longer the time it must take up, as mathematically speaking, wherein to be performed, but as with a proper recoiling, and artificial cycloid, rightly adapted, not so, viz. as when in such largeness of vibration as must to this purpose, as well as to other purposes, be as the most necessary herein required, and as when, as must unavoidably be the case, in the moving by the draught of a wheel, or of the wheels of a clock in the medium of air; neither, as by any means, does a suitable matter of this, viz. of the air's resistance, want to be avoided, as many have foolishly imagined, but is of real or great use, as the which I shall shew presently; and so, as I may make bold to say, there has not as heretofore appeared in the world, or to the public, any thing towards a strict, or rather, as along with other things of mine, to, as I may say, the most strict or exact mensuration of time; and where they must find any other thing or things equivalent, as according to Mr Maskelyne, viz. equivalent to my clock here, or to my watch as hereafter, I do not know, nay, there is substantial reason to think, that they will never be known, no, although as without reason they should still make a many more trials. But to return, I have above in this note, viz. as in a parenthesis said, as may hereafter be observed by the drawing, *i.e.* not meaning the drawing and its explanation to be along with this writing, my encouragement not having suited, or, as in other words, my reward for the watch being too backward, so there cannot well be an obligation for that at present, altho' it be the first step; for I was only, and unreasonably, compelled to explain the watch, viz. so far as I had then advanced therein, and thought as concerning its principal parts, but indeed at that time (though I told them what I thought) there was on my behalf, some mistakes (or not right understanding) as touching some of the contrivances in the same; and here it may, or is to be notified, that from no

indeed this must be with supposing, as in the note, or as with taking for granted, that the pendulum must be rather shorter when warm than when cold) and so by means of something at the top, but not according to Mr Huygens demonstration of the cycloid (for that would not suit the matter at all <sup>8</sup>) it is brought to such a degree of perfection, as not to gain or lose so much as one second in a month; <sup>9</sup> the (..continued)

experience of any sea trial (viz. as in my way to work) is or was any improvement ever to be made; no, such trials (or sea trials) as with respect to what I have done, could only be as a loss of time, or hindrance to the matter (save only as once, in order to fulfill the letter of the Act of Parliament) but, as notwithstanding, through unskillful, interested novices, viz. as put in power, and though at the same time learned men, (stiled Reverend) great trouble and hinderance, and as attended with great expence, has that way been occasioned, \* {they not ...

*\*And whenas, I say, that as touching the thing in itself, no sea trial at all was needed, but there did indeed want more land trials, by a pretty many, than what I had time to make, viz. so as from whence to have brought the thing to what it is capable of bearing; but still it was not so ill as Mr Graham's first setting his pendulum a going, and not after that, to make any such experiments, so as whereby to know whether or not there was any room --- ever to make it better, (as according to page 5, &c.) nor could any land trial of my first watch by a novice, ever direct towards making the same to be perfect.*

they not wanting to have my true ingenuity to do; whenas at land (thro' my continued diligence, and the nice performance of my clock, and as without any foolish obstruction or interruption,) I discovered (or found means to discover) pretty much for the better of late, viz. so as whereby to come up to such great exactness as I shall speak of below; nor does the watch, or will the watch, as by way of trial, as just here above implied, ever need any farther than what belongs or must belong to its adjusting, viz. as by the help of such a clock as mine, or rather of such a clock as my next will be; and the mistakes as here above intimated, must remain to other workmen, viz. until they be as by or from me the better instructed, until I be (for a public good) the more freely, or the more genteelly rewarded than what I have as hitherto speakingly been, viz. for what I had so highly, or so deservingly done; no, the remaining part of my discovery (and as still the more valuable) shall (excepting better usage) sleep, save only so far as to be to my own content or satisfaction, for not one stroke as farther will I take; nor shall I endeavour to seek after a place at which to prepare an observatory, with suitable conveniencies, for or to the purpose; but as being paid short, and that as farther withal, to be attended with a great deal of expence, trouble, and hinderance, (scurvy work) I will also be short, viz. as in a suitable degree, excepting as intimated, I, or my discoveries, can as hereafter meet with better usage than what I have as heretofore met withal; for certainly it must be worth all, nay more than all the money it was to cost, as being so extraordinary a matter, or rather, as taking in the clock, such extraordinary matters as were never to be expected to have appeared in the world; nor, as there is good reason to suppose, had it not been from me, would never have so appeared, (as being so far out of the beaten path) and still I must be used ill. What, the longitude, an affair of such importance, and as when to be had in so correct, easy and useful a manner, nay, as here implying more than that, and yet to be so used! O fie!

<sup>8</sup> That demonstration holding no farther good, than as at the spring (as they call it) at the top of the pendulum, could be supposed to be without strength as with respect to its bending, or application to the cycloid; and as notwithstanding, still to be strong enough to suspend the pendulum; and that also, as if the pendulum should move, or was to move by itself, or of itself in vacuo; consequently that demonstration must at least, as with respect to the long pendulum way, viz. where the arch of vibration needs not to exceed 15 degrees, and where, as always, or as unavoidably, the draught of the pendulum-wheel of a clock must be taken into the question, must, I say, do more hurt than good, though not at all so to be considered by Mr Huygens, &c. yea, although in this point the mathematicks or geometry has so far with mischief, and as only so to do in the matter; but more of this hereafter.

<sup>9</sup> A strong proof indeed, that the force or draught of the pendulum-wheel of my clock, and as in the first place to be understood, with its right duly adapted proportion, and that as partly for its number of teeth, corresponding to its revolution of 4 minutes, but as thence in chief, or as indispensably so to be acquired thereby, (viz. from which the said proportion) such a qualification as whence, by my construction of the pallats, the said force so to be disposed of, as to give to the pendulum no more irregularity in the maintenance of its motion in air, than as if it went, or could go by itself, so as to be observed to what truth it had continued to measure time, viz. as by

suspension of the pendulum (a thing highly material in the matter) being from the brick-wall, as having nothing to do with, or as having no dependance from the clock, its case, or wainscot, for if not so, the true goodness of what I have shewn (or as even of more than what I have shewn) could not be had, <sup>10</sup> and withal (as not to pass unnotified) the clock, from its construction, &c. is never to want any cleaning. <sup>11</sup> But here, as I promised above, (page 9) it must be highly worth notifying of how

(..continued)

or from its going by itself, and that for a long time in vacuo; and therefore I may ask, if such a matter be not highly worthy encouragement, what other sort of ingenuity or discovery in the world must be so? my longitude time-keeper, own sister to this, excepted.

<sup>10</sup> For it is to be understood, that I had, after some disagreeable experiments, discovered, that if wood was concerned in the suspension of the pendulum, viz. wainscot, the clock case, (and as consequently in the common way, but out of the question with me, the raising-board upon which the clock stands) the clock would as thence go faster in moist weather than in dry, the strength of such a suspension becoming as thereby, viz. by moisture increased, but it must be more or less so, accordingly as the wood may be of strength or substance. Now, at some years after I had communicated this to Mr Graham, he upon some occasion removed a clock from one side of his room to the other, and when fixed up there, he found it to go about 6 seconds a day different to what it went before, and the which, from the great care he had taken in the removal, could be attributed from nothing so much as from a different strength of the wainscot; but as being very surprised at it, (notwithstanding what I had communicated to him) he removed it back again from whence he had taken it, and fixed it up there to the same fixings as before, and then it went about as what it had done before; after which (in the same place) he put another bar of wood betwixt the back of the clock-case and the wainscot, and screwed the back fast thereto, and the ends of the bar (as on course) to the wainscot, and then it went faster, and the pendulum played farther; now this made or occasioned a great alteration in Mr Graham, viz. as touching the whole of what he had done; for, upon serious reflection, he thought that such as that might not at all times be all; but that as together from what might pertain to the littleness of his vibration, and as so from the tremor occasioned by coaches and carts going by, and as with the shutting of doors, &c. and as then to be in a different place of the room might, as with respect to both, have something to do in the matter; and whenas I before had certified him, that, in a right application of a pendulum to a clock, no alteration in its motion could as upon any such account arise, but only, as with respect thereto, from what the pendulum itself could do, viz. as with regard to the strength or stability of what it was suspended from, and as upon wood, and as here by the by, the string, or some one note of the string, of a monochord, set exactly (as by a leaver and weight pertaining thereto) to the note or pitch of a bell (or, if you please, of a great bell, as of 20 or 30 hundred weight) when dry will, when in moist weather, and at the same degree of warmth and tension, be sharper considerably than the said bell; the consequence of quicker vibrations; viz. as then to be from a stronger foundation; but for this experiment, the monochord must be kept in a room where there is a fire. And here I can also as farther assert, that, as with respect to the perfection of a single instrument with strings; (single; I say, because the matter will then be the most obvious) as for instance of that of the viol, or at least as touching the perfection of the same, (it being the instrument upon which I experienced the thing) and as in supposing its strings to be rightly adapted to it, (or as when they are so, &c. indeed) that as then for the acquiring each, or all its notes to be to the best perfection, that, I say, its pitch must be set, as when in dry weather, somewhat flatter than as when in damp, or else its strings must be at too great a tension in the former case, and as I found from experience, its perfection as thence to be in some measure impaired.

<sup>11</sup> But as farther, upon due reflection, it is certain that a clock may still come nearer the truth than my present clock, the which I have here been speaking of; and, as towards the matter, I have for some time had such a clock to the purpose in great part made; but as not designing to fix it up in the not rightly convenient place or house in which I live, I did not hasten its finishing; as wanting withal (viz. as lately had come in my mind) some other or farther experiments trying with my present going clock, and they as to the better completion of my other clock, or of any such hereafter, and as when withal, justice, as touching my reward or encouragement for a public good, was or has been the most scandalously frustrated. O fie, England! an Act of Parliament broken, and for sureness after twice fulfilled; and not as only so, but that as when in the best, most compleat, or useful manner, viz. that is, or ever was in nature to be wished for. For, as to this purpose, it might have been said as in other words, viz. that had such a matter

great service the resistance of the air is, or must be in the matter, viz. in its proving to give, in a suitably large vibration, or in a suitable largeness of vibration, such a properness of resistance as the nature of the thing may be said to require, for without that a pendulum, as under the circumstances I have shewn, (viz. as with respect to its having no sensible friction at the pallats, &c.) would know no bounds, or at least but hardly any, for its vibrations, and consequently could never be occasioned to measure time truly, since we shall never be able to have any account or useful observations about its measuring time, from its going by itself (or as without the wheels of a clock) in vacuo; consequently it must be very improper for a small vibration to be, viz. where the force from the wheel or wheels must be but very small indeed, and where as thence chiefly from a small quantity of friction, and as may, for badness, be said, *at a great distance from the center of motion of the pendulum*, the same to be so limited, viz. for during all the time, that it, by the oil, shall chance to go, before it (the clock) comes to stand, and wherein as in consequence thereof, (and as already implied) a little difference in the said small friction, will continually keep bearing a great, uncertain, or irregular proportion in the whole maintenance of such the pendulum's feeble motion; for though a pendulum will, or can by proper means, naturally perform all its vibrations, although of different extent, exactly in equal times, yet that it may indeed do so implies, that it must not have any the least corruption from the wheels of a clock, &c. and therefore, as again, or as in consequence of what I have shewn, viz. as touching the most proper circumstances, no small vibration can ever to the purpose be rightly maintained at all; the resistance of the air, as taken into the question by a conveniently large vibration, (viz. convenient in other respects as well as in this) and as when properly ballanced, or counterballanced as above, making by far a much better controller or master than, as in a small vibration, any little quantity of friction, and as such differences in proportion as will unavoidably happen therein, can ever with reason be allowed to make, or rather, as in other words, can ever possibly so be found to be; nay, if the vibration be very small, it must become even quite insipid, and not worthy of any observation at all; or even when so small as to be but about 2 or 3 degrees in the whole, it could but hardly be esteemed as any better, was it not in some measure to be made out by logginess, massiness, or excessiveness of weight in the pendulum, or even as it were in other words, by an enormous weight in the bob; but indeed, as so, it may or might (as with a provision for heat and cold, or as with something greatly towards the effects thereof) do better by much than what had been done before; but still certainly, it cannot be taken as a wonder, if a little difference in glibness or clamminess upon the surface of such pallats, and as at such a great distance from the center of motion of the pendulum, viz. as Mr Graham disposed it, and as together with such his coincident feeble vibration, I say, it cannot be taken as a wonder, but that the

(..continued)

as in the whole remained as fact, it must indeed have been a very great shame to the nation; but as just now, viz. before the publishing of these papers, the case was altered; the chief instruments of which fraud, viz. the vile holy priests, were over-set, their ingenuous, or disingenuous villainy, being at the height, or as when got to the height fell, and indeed it was a very great fall, the matter being got so excessively high; and if they should rise again, yet still it can never be so high as to see at all times, (if ever at any time, so as to be depended upon) viz. the longitude right clear by the moon.

clock may vary, as thence by times a second in a day; whenas, if proper steps be taken, *or can be taken*, in or for the adjusting my next clock, there must be then more reason (and that withal, as from experience in my other clock) that it shall perform to a second in 100 days, yea I say, more reason, than that Mr Graham's should perform to a second in 1. And now how far, or to what equality, the properties treated of above, viz. as touching my pendulum-clock, are preserved in my watch, or time-keeper for the longitude, may in some measure be observed as followeth.

As first, the radius of its ballance, as with respect to that of the circle, the portion of which the edge of its pallats describe, is about as 32 to 1, <sup>12</sup> so it is in effect, from properness of weight in the rim of the said ballance, and strength of the ballance-spring, (the strength of which as below, producing more force than what natural gravity as in a pendulum can do) and as together with the largeness of the arch which the ballance fetches or describes, viz. as about 255 degrees, and that 5 times in a second, and as withal the small force it has from, or its little concernment with the wheel, (not meaning very little or small in itself, or inconsistently small, as liking in fact to a creature that's sick and unactive, or as according to Mr Graham's way for the pendulum, but only as properly, or as it were reciprocally small, in regard to the smallness of the distance at which the wheel acts from the center of the ballance, viz. as with respect to the radius of the same, its weight and arch, or rather arches describing) there must, I say, be in effect, a much longer pendulum, or such a thing as must have a much greater power whereby to regulate, than Mr Graham's pendulum that swings, or rather creeps, as he managed the matter seconds; natural gravity exerting but very little force there, (viz. as towards the matter of truth in Mr Graham's pendulum) as being improperly, more to be compared to the motion of a comet in its aphelion, (*i.e.* so as that a little may disturb or alter it) than to the motion of a planet in any part of its orbit, and as whence to be looked upon, as seemingly a matter so contrived, as if it was for fear the pendulum should do any good, yea, rather than it should any, viz. as when considered in a right light or manner; for, as otherwise to the same signification, the less the vibration of any pendulum, viz. whether heavy or light, the more in nature it must debase, approach or decline towards the bad effect of a ballance of such the same weight, &c. and as with such the same insignificantly small vibration; and indeed as so, and as together with what bad I have shewn as farther, or as still naturally to attend it, was I to set up such a clock, and in the manner in which they commonly are set up, I could but, as from the nature of the thing say, that I had only set it up in order (as for a rude trial) to see how it should chance (as according to Lord Morton) to go, or to continue in its mensuration of time, viz. as with regard to the matter of exactness.

Now in my longitude time-keeper, (pursuant to what has been said) the strength or command which the ballance-spring has over the ballance, as in proportion to the force it has from the wheel, is so great as 80, or even as more than 80 to 1; a strong artificial gravity indeed, (for so it may be termed) as even in

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<sup>12</sup>The radius of the balance being 1-1/8 inch, *i.e.* in a decimal 1,125 inch; and that of the pallats 0,035 inch.

effect --- much surpassing natural; <sup>13</sup> whenas, as barely in which respect, viz. besides the other necessary or very material circumstances attending, or the which ought to attend, (as correspondant to what I have said of my pallats for the pendulum, and of which there was no notion in the world before, but of the manner of which as touching the watch, neither of that of my provision therein for heat and cold, I shall not treat here or enlarge) they never did in the common way, nor, as there is good reason to suppose, ever would have exceeded in this grand point, (viz. in the quantity of force which the ballance has from its spring, as in proportion to what it has from the wheel) any more than as about 3 to 1; not that any, either amongst the watchmakers, or men of liberal sciences, were able, or had in the least considered, how far indeed, as towards such a matter, they only had, or there only was advanced; consequently, as touching the point, had never found any occasion to consider, whether or not they might ever be able by any means possible, to advance any higher, (viz. before that some of them had heard me speak about it) or rather, whether or not it was, or could be at all material, for it so to be, viz. in this --- the most material circumstance, any higher or farther advanced, and that in such a bulk or size of a watch, as might for the purpose be the most conveniently chosen; whenas, without which, no provision for heat and cold, &c. (had any such thing withal been thought to have been wanting) could ever be, or could ever have been, of any true service in the affair. But here it may not be amiss for me to remark, that after I had discovered, viz. by doing something as by way of trial towards this matter, that it was after a many toilsome experiments or alterations, that I did indeed succeed to such a surprising degree as I did, a

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<sup>13</sup> The limb of the ballance moving thereby through about 25 inches in a second, notwithstanding, as in that time (and as still an augmentation to its power or dominion) its motion being changed to contrary direction 5 times; and as from which it must as in consequence be as farther allowed, and as withal considering the arch it describes, that its motion must be prodigiously quick, or even violently powerful in the middle of each vibration, and when, as even without that, 25 inches in a second, is no less than 34 miles a day; so rapid and powerful is the motion of the ballance, for faint sleepy work could never do; and whenas no such velocity (as in this point for the better) can be in a pendulum, viz. in such arches as in the long pendulum way are commonly, or can as the most properly be described, until it comes to the length of 13 feet, and then it will still not be in effect so quick, nor consequently so powerful, because of its not having in effect so much velocity, but only so much as whereby to accomplish a vibration, or such a space, viz. as without any returns or return, in the space of two seconds of time, \* {but here...

*\*But still, as by the by, it may be noted, that there can be no occasion for a pendulum for any church clock whatever, to be any longer than as to swing 2 seconds.*

but here, if it should be alledged, that the length of such a pendulum is much longer than the radius of this ballance, it is then to be remembered, that (as in common) the lengths of the pallats, &c. are to be taken into the question; and, as already in some measure implied, it is as farther to be understood or remembered, that in such --- these mechanical cases, that no ponderosity in a pendulum or a ballance, can rightly or ever make up --- the want of velocity; and indeed velocity was very much wanting in my three large machines, yea, I say, very much, notwithstanding their weightiness of ballances, or as notwithstanding what philosophers may reason in other affairs, or rather what philosophy in this affair (viz. as hitherto through mistake, as from the steel-yard, &c. in the matter) might teach us to reason; but I did not then (viz. as in the designs of my three large machines) so thoroughly understand it, nor should I, or the World, (as I think I may make bold to say) ever have understood it, had it not been, or had I not discovered it as it were through accident, in or by my third machine; but as it would be more tedious here than necessary, for me to fully reason the matter, I shall forbear it; but still the knowledge of the same is highly material.

strange difference for the better, being betwixt 80 to 1 and 3 to 1! I say this was attained by a great deal of labour, but it was so as wherein withal (and as with a great vibration) to be thoroughly satisfied, that it was, or is, as far as possible --- to be acquired or done; so therefore, if Mr Maskelyne should (after a long time) find an equivalent, it is not possible for him to go any farther.

And now that this great or chief matter as above, is indeed so much as 80 to 1, is to be understood or perceived as followeth, viz. as in that from the force of the ballance-wheel alone, *i.e* as without the ballance-spring, the ballance will be almost 2 seconds in fetching 1 vibration, whenas with its spring, it fetches 10 vibrations in 2 seconds, and it is certain that different velocities are, or must be, as the square roots of their forces; consequently if the ballance, without its spring, or without as it were its artificial gravity, took up 2 seconds, wherein to fetch 1 vibration, and wherein it fetches 10, the wheel would then but have the 1/100 part of its command; but here it is as farther withal to be notified, that if, or as when at any time, any small difference happens therein, viz. in the said eightieth part, as indeed small, such a matter must be, or can but be, as with respect to the whole force of the ballance, yet still I say, the same as in the same contrivance, to be taken in or accounted for; hence, as still farther concerning this matter, or rather now, as unconcerning the same, and that besides what might have ever arose from the common experiments of workmen, viz. nothing, there is not, nor could ever have been any likelihood, as above intimated, that any assistance or discovery herein should ever have shewn itself, or appeared to the world from such mechanical illustrations or operations as they exhibit at Cambridge, Oxford, &c. as being for the most part only such experiments as need not at all to be tried, (hornbook work as it were) but as granting them useful in the most common respects, they could never however have had anything to do with this discovery of mine, as being as it were quite repugnant to them, or at least quite out of the run of that channel; but still, or as notwithstanding, as such weak, or even very weak mechanicks as touching this matter, viz. such as neither know, nor can be made to know any thing of the matter, <sup>14</sup> but yet must, as in the most stupendous, but surfeiting manner, be my masters! But then as so, it may as in consequence be said or asked, what was there to be expected? and as when moreover, as at the same time, or all the while to be rivals and antagonists, by another way as they would have it for the longitude, viz. as by the slow and intricate motion of the moon, and as whence, or wherein to be attended with great difficulties and uncertainties in the making observations, and consequently the result to be for the most part attended with very great error, insomuch (as without the taking any

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<sup>14</sup> For in particular, I took some pains with Mr Shepherd, (viz. when he was my friend) but could make nothing of him, (viz. any farther than that one wheel turned another) although it was at his desire: very unfit gentlemen to be my masters, the reward for the longitude (I mean part thereof) being to be detained in their secret closets for during their pleasure, as having in, or for that interim, a pretty reward; but as notwithstanding they took great care about my watch, for they also locked it up for some months in a closet at the Admiralty, - because it had performed two voyages so well; and so they would keep it as a piece of treasure, for fear nobody else should ever be able to make such another; a fair sign indeed, that they did not understand it, and consequently to be taken as an absurdity that they should (at that rate) have had any thing to do with it; but to make it worse, Lord Morton, for want of understanding as well as they, put or infused chance into their heads.

notice of such - the operose calculations that must be required) that from the experience which Dr. Halley had had in the matter, it so, or at last appeared, or was found by him, that if in case the Lunar Tables were ever so correct, that even still, as from the observations alone, (viz. when they could be had) there could no certain good ever come from that way to work, viz. so as to be relied on, and upon which account chiefly it was, as Mr Graham told me, that he (viz. Dr. Halley) ceased his pursuit in the matter; an ingenuous decision indeed (since, as already implied, no proceeding therein or thereby could ever with any certainty tend to a public good) for it is still certain, that such observations cannot be any better made now, neither with any more frequency be had, than could be then, viz. in Dr. Halley's time.

Now, from my experience, I can make bold to say, that my watch (or time-keeper for the longitude) will come up to 1 second in a fortnight, viz. as when my last piece of improvement, and as with a little alteration, viz. so as whereby to receive it, is put in execution, <sup>15</sup> the which I described in drawings in the latter end of the Year of our Lord 1772, and as then in the 80th year of my age; and surely it ought to be looked upon as an age well spent, <sup>16</sup> as tending so highly to a public good, (*i.e.* if it may be so let to do) as well as to the making hereafter a pretty employment for ingenious men; though not for priests at Cambridge and Oxford.

Now I promised above to say something farther as with respect to the pendulum. I have said that Mr Huygens demonstration of the cycloid can be of no service in the affair, viz. no farther than as if it was supposed to be in vacuo, &c. if that may said to be of service; and whenas (whether in vacuo or not) was it to be applied to a very thin spring at the top of the pendulum, (for thin to the purpose it must be) <sup>17</sup> it would only occasion the said spring to neck, or break off at the top of the cycloid, and that in a short time; nor can the arch or arches, as described in the long pendulum way, (as supposing at the most 15 degrees) be but hardly said to want it, (viz. as in the manner demonstrated) therefore such a matter as must be in lieu of what is called a cycloid must be chiefly to preserve the spring (or suspension of the pendulum) from its ever breaking, and the which spring, as being to be very thin, (but may be short) must be best to be made of gold, <sup>18</sup> properly allayed with copper, and to be well hammered before it be brought to its thinness, (as being then more elastic, than as if or when allayed with silver). Now

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<sup>15</sup> The which improvement being to be in the parts which are above (as work-men termed it) the upper-plate of the watch, and as with a little alteration of the shape of the pallats, but as easier for the future, in all respects to be done, as well as when done to afford a greater degree of truth.

<sup>16</sup> Considering what tedious proceedings, in or for experiments, belonging to this must be required, viz. so as to purchase, or to find out the secret way, (or rather some secrets in the way, and them as the only true steps) so as whereby to make a thorough conquest of the thing; nothing to the matter being done before!

<sup>17</sup> Consequently the pendulum here not to be so monstrously heavy as according to Mr Graham, the thinness of the spring not to bear with that, neither does nature so bespeak it to be; but that, as on the other hand, or as in the most natural course otherwise.

<sup>18</sup> And withal (as here the bye and bye) the pin, on which the pallats (as of wood) have their relative motion, and that as with friction insensible to the pendulum, as I have shewn.

the nature of such a matter, or cycloid to the purpose, (and as consequently withal for preserving the spring) must be as in some measure reverse to what is demonstrated by Mr Huygens, &c. that is, it must be so as to occasion little vibrations of the pendulum, viz. all such as are less (and unregarded) than so as to let, or such as will let the pallets interchange, to be still sooner performed, than what they would as otherwise be without it; and at such an arch describing, as whereby just to let the pallets interchange, or as rather at a little bigger, the length of the pendulum to be so (viz. as by or from its adjusting) as then to swing seconds, and also, as when in its fetching farther (as from the nature of such a cycloid as must be, and as when together upon such other foundation as above described) the same; for as thence, from the continuation of this circular curvature of the cheeks, (viz. of this artificial cycloid) that matter, as here in hand, is to be ascertained, but of the radius, in each to the purpose, viz. as subsequent to the action of the pallets I shall not here speak, nor can Cambridge or Oxford education have any thing to do with either that or the action of the said pallets, (viz. so as to define such a matter or matters to exactness, had such particulars as them ever before been thought of; but however, as each cheek, with regard to the property I have shewn of the pallets, or as a tenor to their result, must be the arch of a circle, (viz. for so far as will, in this material point, be suitably wanted or used, *i.e.* besides an overplus of the same for its more truly making) it can be done to a mathematical truth, whenas the other (as according to Mr Huygens) could not, was it so to be wanted. So now to the purpose it is to be understood, that from the force or draught of the pendulum-wheel, as being by the pallets properly disposed of, (viz. as according to the note, page 9) and as wherein with a proper recoiling of the same, that the cycloid may be so, as that when the said wheel may have (or as when in occasioning the said wheel to have) somewhat a greater force, I say the vibrations of the pendulum, as thence becoming bigger, may still be performed exactly in the same time, and as also the same when the air gives or may give somewhat a lesser resistance to the pendulum, so that its vibrations become somewhat greater without any more force from the wheel, and this, because for the most part, that from the same cause which will lessen the resistance of the air, the pendulum is to become in itself, as mathematically speaking, shorter; and indeed from the whole of what I have shewn, a great exactness in the measuring of time is to be had; for withal, it is to be considered, that the draught or force of the pendulum-wheel, in my sort of clock-work, will alter but very little, neither the vibration of the pendulum, as from thence, or any other cause, much at any time, or in any sort of weather; so no wonder certainly (as from the whole) at the nice performance of such a clock, or fine contrivance of mechanism, as the which was indeed to the astonishment of my great and worthy friend Mr Graham; and it is certain, that the result of such as this (viz. as when to be had from a watch - rightly or thoroughly converted must be the nearest relation to the longitude, nay, even from its easy and proper application - the longitude; and yet they that must be my masters, knowing nothing at all of the matter, (viz. of such mechanism, <sup>19</sup> it

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<sup>19</sup> But as notwithstanding will still, as by pretence of trial, and through the power invested in them, employ any who know as little of it, or about such mechanism as they themselves do, an evil case sure! Their Cambridge and Oxford mechanicks (as above) not reaching that, (the very soul as it were of the matter) but as on the other

being as it were not only repugnant to their learning, but withal, as they imagine, the loss of a booty to them, for Dr. Bradley once said to me, that if it had not been for my watch, <sup>20</sup> that he, as jointly with Mr Irwinn, (and I may say, as opportunity of ignorance then served) could have had £10000 and so my masters (or rather improper inspectors) would still have people to be in love with such other things as wherein to make the best of (viz. as without the taking any notice of the great trouble attending) must, at least, be far more, if not even a hundred times more difficult to tell to a degree of longitude, and that only when opportunities may happen, and such as will but be seldom, than to tell what's o'clock to a minute by the hour-hand of a watch. This cannot be denied by any. But as here to return to the clock, it must be indeed, as at first to get such a clock to be really or truly adjusted, *i.e.* to what it will bear, or is capable of bearing, viz. as without another of the same sort --- no easy matter to be done <sup>21</sup> and that because of deficiency in, as well as scarcity of celestial observations, as not being in the time of adjusting, neither with frequency nor exactness to be had, viz. as when most to the purpose wanting. Now this is meaning, as without what is to be done by the screw at the bottom of the pendulum, viz. for fast and slow in general, that being an easy matter, viz. when the others are really done; but when, as after once in that, as well as to be in the first place, in other respects adjusted and to stand in the same, but proper place, it will hold to its truth, as I suppose, or have, from experience, reason to believe for ages; <sup>22</sup> not meaning but that it may be removed from the

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hand, or rather as on the contrary, have writ and published a great deal of stuff, pertaining, as they think, to the longitude, or at least would have others so to believe it to be; whenas it is still no farther than as what Mr Whiston did, viz. by his throwing up a bomb (in the dark) at Shooter's-Hill, (as taking so to do soon after I came) for the which only made or could make a great noise, and the greatness or impertinence or the superfluity, as not having any thing to do in the matter, (viz. as in their nautical almanac) can do no better; for, as touching the same, was they to be asked, what is the useful intent at sea of such a column therein, or such a column, or such a column, nay even to 40, &c. in a month or each month, their answer in the main could be no better than nothing! as being only a deal of stuff, so as whereby to dazzle the world, for though ever so true in itself, can have nothing to do with the longitude at sea! O strange, that any of the commissioners should suffer themselves to be so imposed upon! I wish not only they, but that all the nation understood it as well as I do.

<sup>20</sup> The which, by the by, I believe was his death, because he, as the only one amongst them, did indeed, from his oft conversing with me, and sagacity in the matter, understand it; viz. what it was likely to do; but still (as previous to his conjunction with Mr Irwinn) seemed to be very sorry when I met with any difficulty, as chiefly in that of the diamond pallats: no difficulty now.

<sup>21</sup> There being to be concerned in that proceeding, four different things, and wherein two of which (as touching the point) do as it were pretty much conspire to, or in the same purpose, viz. the composers of the pallats to relative rest, and the correspondent curvature therein of the cycloid cheeks. I say, these two things may only as almost be taken as one, viz. in their joint effects, for so far as belongs to this matter, but not quite so; and the other two particulars in the case, are the adjusting (viz. by a proper provision) the wires, or the redoubling of the wires for heat and cold in the pendulum, and the screw for fast and slow in general at the bottom of the pendulum. And as hence I may say, as rectifications in these different things must pertain to the clock's adjusting, (viz. at first by the master workman) it is or must as therefore be a thing - quite impossible to be done to exactness or perfection, by or from any celestial observations whatever, no, nor indeed by or from any other means whatever, unless (as here meaning of course) the foundation and principal parts, or rather principles of the clock be to the purpose as I have shewn, and could as then still farther shew.

<sup>22</sup> But here, as by the by, I may notify, that a professor, as great as any of the rest, and who rudely made an

place, or a place of convenience, wherein as at first to be adjusted, viz. by the maker, &c. to any other proper place, and there or then (viz. after duly fixed up, or as in other words, after a firm and skilful fixing) to be as again adjusted, viz. as with respect to fast and slow in general, as the latitude of the place may require; and the which (as above) no great difficulty; whenas the first, as the far more essential part or parts of adjusting, must be very difficult, viz. as when alone to be done without another such clock, and that as the best when already adjusted, and so as whereby, by the seeing of both the pendulums as it were instant; and as when at the same time, the clocks to be the most properly placed, viz. one in one room, and the other in another, <sup>23</sup> yet still, as intimated, to be at any time, viz. as by a little turning of the eyes in the door-stead (the door of each clock-case being opened for the purpose) compared to the 20th part of a second or less; but as when (and as very troublesome and tedious) without this, a right recourse to the stars, the right ascension of such, as may be the most proper, here to observe by, being to be as yearly known, or even if not known, yet, as the rate of the clock's going may as thence be ascertained, viz. as nearly as such deficient observations (viz. as with respect to this purpose) can be taken or had, must be better than the sun; whence it is still highly to be remembered, that this can never be so easily, nor so well accomplished, as when by or from the two clocks; no, such observations can only serve or suit for the trying of such clocks as Mr Graham's, but as whence to adjust a clock to perfection (*i.e.* meaning such a clock as will bear in good earnest so to be done by) could never as thence be done in an age; the stars indeed will do better than the sun, the Equation Tables not being as yet right, no, not in our late famous, or rather (as to its design) infamous Nautical Almanac, neither, as already implied, can any celestial observation ever be so correctly or so strictly made, as not only, for this matter ought to be, but that as withal, when most to the purpose wanted; whenas by a right use of my clocks (viz. as when with proper

(..continued)

application to me for a clock \* {must little ...

*\*Viz. one of my masters at the Board of Longitude*

must little think, as from their shortness in the matter, and great abuse of me of what really ought to belong to the having an astronomical clock, or as otherwise to that purpose nothing, for (as otherwise with respect to the same) I am very sure, that I should then neither think it, nor find it worth any thing at all in the affair. \* {But how ...

*\*They can indeed tell us of what will be the result of the motion or motions of two marbles (such as boys play withal) rapping or impinging one against the other.*

But how the nation (or world) must, or will fairly come at what is much better, or truly fit for this purpose, ought to be fairly or rightly considered; not but that I once thought of giving a clock to the observatory at Greenwich, but my bad usage proved too tedious for that; but still, as already hinted, my next or second clock will be somewhat better than if it had been finished sooner; and if I live to see it done, that will be my wages in the matter; but one would think, a minstrel at the play-house is much better off, save only that this has been my great delight, and must be more noble than his achievements.

<sup>23</sup> A chimney being in each, so that either one of which rooms may be made warm with fire, viz. when properly so to be wanted; and then, if indeed neither of the clocks was adjusted, it would be no great difficulty to get them both so.

conveniencies, and proper apparatuses) even that piece of astronomy (the Equation) may hereafter be corrected, because as thence the eccentricity of the Earth's orbit, and whatever else may pertain to the matter, may be the better known. But it is to be understood, that my watch in its perfection (and as without any trouble of fixing, and not as only so, but as partly withal, as thence to be attended with far more, or further usefulness, in different places than the clock) would be the best for a Transit of Venus, &c. was there, or be there such a matter as still or as again to be thought to be wanted.

And now, if the Royal Society please, I will shew them the draught of the clock which I have in great part made, and not only the draught of the pallats, as in particular, but also the pallats themselves, in order that they may see at least some reason for what I found, or might as in consequence find from such a contrivance of pallats; but not meaning as only from the extraordinary qualification of, or in the same, but as together from other things, and as besides them the which I have treated of; but still, I say, the indispensable construction of the said pallats, viz. for their duty as above, and as must in consequence, or good reason, be with or from due properness in the extension of the periphery of the pendulum-wheel, and the number of teeth in the same, (viz. as then answerable, in its beating seconds, to its revolution of 4 minutes) for otherwise (as presupposed in the note, beginning on page 9) they could not do their duty, viz. in their so properly acting upon the pendulum, as must for a nice, or true performance, or as in other words, for a constantly strict mensuration of time be required; <sup>24</sup> whence they the said pallats must, I say, amongst the rest, be to the purpose by far the most principal; and this my great and worthy friend Mr Folkes, in his speech to the Royal Society, (30th November, 1749) in some measure represented; but certainly it must, from what I have shewn, be fairly visible, that as in comparison thereof, and withal as taking in the bad circumstance of oil, or difference in friction (was it, or could it be even without oil) at such a great distance from the center of motion of the pendulum, as in Mr Graham's way, and as together with the smallness of the vibration as cohering therewith, that it cannot (I say) be otherwise looked upon, but as a matter or matters quite ridiculous, as being even quite repugnant to reason; but a pendulum, with a provision for heat and cold, and from a firm suspension, must do something, but certainly in or towards which natural property, it cannot be said that Mr Graham's pallats can do any thing, for no worse thing could be well contrived than they are, as being only as it were a meer jerting, stamping, nonsensical fancy, <sup>25</sup> as if so designed, as that the clock might as thence

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<sup>24</sup> And wherein as withal to be observed, (as intimated page 3) that the wheel is but to move a little in a second, (as half the space of one of its teeth, the which are but straight) but the pendulum through a great space. But here, as without taking any notice of this material matter the vibration, it is to be remembered, that the length of a pendulum, as at the best, is only as in proportion to the length of the pallats, or as more properly to the distance at which the wheel acts from the center of motion of the pendulum, viz. as without any thing to be taken as farther therein for the worse, as the which is still so to be notified in Mr Graham's clock, and that as not in a small degree.

<sup>25</sup> And yet the same to have taken such thorough root, or possession in men's minds, as that, whatever any man may contrive or do, it must be a kin thereto, or otherwise, the first observation or cry will be, that it does not beat dead! a surprising circumstance indeed ! as having nothing at all to do in the matter, viz. as with respect to what must be done, so as to afford the truth, and consequently so as not to corrupt, or as in the least to baffle, the natural qualifications of the pendulum, but as that it may have all its advantageous properties to the purpose, as from the

the better be heard to go, as if no matter how it went or was to go; I say this must seemingly be the case, whatever occasion he might take as otherwise at first to think about them; and in the whole, as in comparison to the account I have given of mine, one would think must be visibly bad to any of judgement, and as even without experience, (no strict regularity, as I have shewn, being as thence with reason to be expected or afforded, at least for any continuation of time.) But now, as farther, (and as according to my same worthy friend Mr Folkes's prediction) it certainly is as still more highly to be notified, viz. the construction of the pallats of my now small machine, watch, or time-keeper for the longitude, <sup>26</sup> and especially as in my last drawing, viz. so as wherein or whereby exactly to suit in each or all respects, as well as my other pallats, to the nature or property of a pendulum, (viz. more properly than as in my first watch, nay, somewhat better, or more to the purpose, than as at present in my second watch) and still as not to pass unnoticed, the materials of which the ballance-wheel and pallats respectively are made, viz. the wheel of steel, quite hard, and the pallats of diamond, and as whence, so far as I am hitherto able to judge, they will hold to their figures for ages; neither will the watch in any other respect (but as chiefly from my last drawing, and where the pallats will also be somewhat easier to be done) hardly ever be out of order, but as above, to point out the time (and that whether at sea or land) to a second in a fortnight; and had not my proceedings been foolishly baffled, this our nation might certainly have had some benefit from them before this time; but as on the contrary, meeting with such extremely ill treatment, I did, for some time,---even hate to think of so much as ever any more to occasion one wheel to turn another, whenas there is a great deal more than what that contains to, to be thought about in the matter; but, alas! it is to be supposed, as a great advantage for such ill treatment (or bad matter) to be, was my being neither University-man, Knight nor Earl, &c. insomuch, that even an Act of Parliament could not possibly, or at least not so well, as on my behalf stand good; but still I had not, nor must not have any intelligence whether it would or not---until some time after my son was returned from his second voyage, notwithstanding his being sent upon both voyages by virtue of the said Act, and the longitude (by my time-keeper) to be had in each or both of them, even to much nearer the truth than what by the same was required! A fine commendation sure to the nation, viz. in one respect, but quite contrary in another. But had it been possible that the Professors of Art or Sciences at Cambridge and Oxford, as from their high algebra, &c. <sup>27</sup> could have been able to have discovered or to have comprehended such mechanism to have been in nature, as I am now, by the blessing of God, master of, viz. for time-keeping, and I to have

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largeness of vibration, &c. as I have shewn.

<sup>26</sup> Viz. where the vibration, or as workmen, term it, crossing, must to the purpose be very large, and so as thence consequently, from its 5 vibrations in a second, the weight, but as more especially from the largeness of the diameter of the ballance, its motion to be very quick and powerful, or even as it were boisterous, as I have shewn above, page 14.

<sup>27</sup>Not from divinity, by which they wear their gowns, for that would but hardly have let them to have, or ever to have had any thing to do in the matter.

been apprised of it, (viz. of their knowing that) and still, or as notwithstanding, to have come out of the country from where I did come, and as with a scheme or description for finding the longitude by the moon, and as when the use of which must, and as even at the best, or seldom opportunities stand, or rather turn upon such tickle points or uncertainties as it must do, <sup>28</sup> and of which the professors must hardly, or presumptuously be said to be ignorant; what a fool of a fellow must I then have been! yea even so, as neither to have been heard to speak to Mr Graham, nor to any body else, viz. of any understanding in the matter; but however, be it now as it will, if it so please almighty God, to continue my life and health a little longer, they the professors (or priests) shall not hinder me of my pleasure, as from my last drawing, viz. of bringing my watch to a second in a fortnight, I say I am resolved of this, though quite unsuitable to the usage I have had, or was ever to expect from them; and whenas Dr Bradley once said to me, (not but that I understood the same without his saying it) viz. that if time-keeping could be to 10 seconds in a week, it would as with respect to the longitude, be much preferable to any other way or method. And so, as I do not now mind the money, (as not having occasion so to do, and withal as being weary of that) the Devil may take the priests; for Dr Bradley owned to me, that as otherwise in the matter, there might be always errors in the tables; always error, viz. in some respect or other in the making or preparing an instrument; always error in the observing; and always error from the refraction; and as moreover owned, that as still in the whole, a little variation from the truth (and as without taking any notice of what was to come from the performance of a common watch, its setting, &c.) might be of extremely ill consequence in the affair; and yet it seemed that, for the love of money, he could even have broke through all! And now the parsons still want to prefer such the same method for the longitude, viz. such as will always be attended with very great difficulties and uncertainties, and besides the very troublesome and tedious calculations, which must as thereunto belong, and as wherein to be liable to mistake, <sup>29</sup> and consequently may sometimes or often times, as from the whole, be attended with great damage; I say, for the love of money, they the professors or priests want to prefer this, above what may be done with ease and pleasure, and with pretty great frequency to a great degree of exactness, (for if the love of money cannot be said to be the case, they must be no better than as if out of their senses, for certainly parsons would never concern themselves at such a rate, or in such a matter, if money was not at the bottom.) But now, as experience in any thing is the best proof of its usefulness, goodness, &c.---when Mr Charles Green (one of the best observers) and my son came together from the Barbadoes, along with Captain Manley, and though for the most part fine weather during the voyage, yet Mr Green, as only on the day time, attempted to make observations, and that as at the time, or at such a time as when the Sun and Moon

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<sup>28</sup>And for which reason as above, (page 16) Dr Halley gave it over; and as being pleased that such a thing as mine was (to a public good) likely to do, (or to be brought to bear) promised to Mr Graham, that, as in consequence thereof, he would attend the Board of Longitude, rain, snow, or blow.

<sup>29</sup>As was the case in one of the two observations, the which Mr Green could only make as below, (as was proved so to be from my watch) and through which mistake, he sweat at his figures for some hours.

were in such situation with respect to each other, viz. as when in distance betwixt 40 degrees and 100, or not much exceeding either way, and as when, in the said time, the horizon happened to be, or to prove, right properly clear for the purpose, and as then, from his making several attempts, viz. as only in that advantageous case, or seldom opportunity, (no attempt by the stars to be made, although as the most from thence to be wanted, for if there had, or he had made any such attempt, it would have been much worse, my watch being there) got in all with much difficulty, two observations, whenas, in the whole voyage, there were but 3 or 4 days on which my son could not as with ease by the watch have observed, had it been necessarily so required; but the Parliament never saw, or was ever let to hear or know any thing of this, or of such as this, whenas such is or was more material to be known than all the rest, as about which so great a stir was made; no trials of the performance of my watch at sea needing to be made, or at least no such tedious or troublesome trials as were made, and the business as in consequence to have been sooner got over, could any right understanding be had in the matter; or as in other words, the nature of such mechanism to have been truly comprehended, and the Act of Parliament so to have permitted it; for then, I say, no trials would have been necessary, save only such as must belong to its adjusting; not meaning adjusting by an adjusting-plate, as in such watches as hitherto common, such a thing as that not having any thing at all to do in the matter; but there are other things as pertaining to the watch here, as well as to the pendulum-clock above, and the which I have not as yet, viz. as in this other case, the ballance, got exactly right, consequently not so truly or strictly to bear to such an adjusting as what the farther improvement which I have spoken of, will render it capable of doing, as not yet having had proper opportunity for it, and that as chiefly because of the trouble and hindrance which the Lunar-Men occasioned me to have; but Mr Ludlam (an University gentleman) says, that I have had time enough, whenas it would have been hard to say whether there would ever have been time enough, viz. to bring, or to have brought, this small machine, my watch, to what it is capable of bearing, and that is to such a truth, as I myself at first, as well as others, (nay, Mr Ludlam himself) could think no other, but to have been--as quite impossible, (a second in a fortnight) but now I am sure it can be matter of fact. <sup>30</sup> I say this might have been the case, had it not pleased God that I have lived so long; and as still to my farther improvement, I may not perhaps hit it quite right at the first, but that some

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<sup>30</sup> But as in supposing this nice accomplishment (or the parts from whence this truth is to be as chiefly from) not to be truly hit upon in every watch, but as in now and then one to be a little wrong, insomuch that the watch may as thence sometimes vary 4 seconds in a fortnight; yet still, certainly that will be a doing its business well; but if more wide than so, it may then be looked upon even as to be done in a careless manner, or by a person or persons unqualified for the purpose; but perhaps it may withal be so foolishly contrived, or varied in its construction, as to aim at its coming cheaper, or to be sooner done; whenas, to have the longitude to such perfection or exactness, must be deserving of any thing, and as in consequence thereof, (viz. of such great safety in the matter) nothing ought to be wanting, neither consequently any such proper conveniencies, so as whereby such watch or time-keepers may the most certainly be adjusted; not implying (or meaning at all) the adjusting of such foreign, or nonsensical things to the matter, as about which so great a stir or noise has been made; neither of such other imaginations as would still be abortive, although as whence pretending to shew how far the thing may be carried, and that as when moreover, or notwithstanding, the silliness therein, viz. as pertaining to the tacking about in a brisk gale.

experiments may be to be as still for a little time waited for; <sup>31</sup> but when once in this, the last point rightly acquired, may easily be done hereafter, and the watch will perform as I have said above, viz. so as never to deceive the mariners any thing material in their observations, (viz. as when in their taking the altitude of the sun, for finding the longitude) <sup>32</sup> and, I think, all ought to be pleased, in that it hath so pleased God that I have had such length of life, &c. wherein to bring so noble and useful a thing to such great perfection, yea, even to nearly the truth itself; <sup>33</sup> but still the professors or priests as above must absurdly think, that the money would be better to them, than this (or such things as mine) can be to the nation, for they wanted so to influence the Parliament, as to have my money, notwithstanding what the watch had done! <sup>34</sup> And now I am sure from my last

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<sup>31</sup> But as thus withal, from the series of experiments, which I at last, through length of time, &c. have been able to make, I can boldly say or affirm, that it is fairly demonstrable, (but I think it neither proper nor necessary here to specify that demonstration) that no time-keeper, whether in the pendulum-way, or in that of the ballance, can ever be able (through any artist whatever) to go any higher, or to better mine, the which, as is fairly to be proved, was far from being the case with Mr Graham. Nor could Mr Maskelyne, was he to keep my watch ever so long, ever be able to direct how to make it better, no, not so, although the first, and certainly to afford room for a much better to be; but I say, was he to set himself upon such a strange or foreign thing, viz. as not only with respect to his learning, but as withal contrary to his bent and interest, he could never arrive in the matter at a *quod erat demonstrandum*, no, neither that it could be, or not be, as I am now sure, in the affirmative, to be the case with me, yea, as surely as that the properties of a circle, and them of triangles, &c. must hold good to eternity. And indeed it has ever been my delight to search after, and to come up to perfection if possible, yea, whether I should ever have had any thing for my labour or not, and not, I say, as only basely or sneakingly, or as with uncertainty, to come up with in the bounds of the Act of Parliament. And for the which perfection, or safety of ships, &c. I have indeed had a long deal of labour, but, I thank God, I have got it thorough; whenas no other pursuit, as rightly to the purpose, will ever be got thorough, and though as with its having already been a work in hand for ages, yet still, as thence to the matter, or as notwithstanding whatever may at any time be wrote or schemed about it, and though ever so true in itself, or in theory, *I say ever so true*, yet still can be but as upon a bad or dubious foundation, viz. as touching any truth or certainty of the longitude at sea; and therefore the more there is of it, and still more to be wanted, the worse as in consequence it must be to be liked, or as thence to be relied upon.

<sup>32</sup>But here it may be noted, that what will sometimes render an observation in this case to be 2 or 3 miles wrong, will or may by the moon make it as many degrees wrong, viz. refraction was parallax, &c. not to be intermingled

<sup>33</sup> But it is to be understood, that to get such a longitude-watch adjusted, viz. to what it is capable of bearing, is not to be done (in any reasonable time) by one or more of Mr Graham's clocks, nor indeed from or by any observation whatever, save only, as by or from the performance of such a clock as mine; consequently any proper place, or proper places so furnished, viz. with such a piece or pieces of furniture, must, where properly wanted, be of very great utility indeed; yea, certainly, far to surpass in usefulness, or highness of use, all other observatories in the world.

<sup>34</sup> But what must these men be said to be done by, when the thing was done (viz. so far as to fulfil the Act of Parliament) before they began? and that in the best manner that was, or is in nature ever to be wished for, but as notwithstanding, would not let it, viz. as in the whole be paid for, but thought it the more proper to rob the proprietor of half his wages. Whiston was pissed on, and Ditton shit on, but surely these men ought to be besmear'd or bespatter'd with both, who, after the longitude was had by a good and easy way, wanted to have it from a very troublesome, tedious, difficult, and uncertain endless method! or rather as from uncertain endless methods! For, besides as from the moon, from Jupiter's satellites, the which, as with respect to our needful purpose of longitude, are not worth mentioning; but still, or as notwithstanding, they certainly must, by the hand of providence, be highly created, as well as the moon, for something else; and therefore they should have told us - for what.

improvement, that by or from the performance of a watch of such a size as may be bore with in the pocket, (but I should not advise for it always to be kept there) - the longitude may be had, and that to a much greater certainty or exactness, as well as with far more ease and frequency, than ever it will, or can be, by the moon, consequently the more by far to be relied upon.

Now, in the former part of this book I have treated about matters pertaining to the strictness of measuring time, and have shewn the deficiencies of such means as Mr Graham had taken or made use of for that purpose; and I have also treated of the improper, troublesome, erroneous - tedious method, which the professors at Cambridge and Oxford would have to be for the longitude at sea: And now I am about to treat of another concern, the which happened to fall in my way, and the which (at least to the Royal Society of London, for the improvement of natural knowledge in every respect) must be well worth regarding when rightly considered (at least I think it ought to be so) as being so secret a discovery; and that is the really true scale, or basis of musick; since for which knowledge, the musicians might have played, or fiddled for ever, and tuned, or have had the organ turned wrong in the church for ever, and the musical part of the mathematicians might have reasoned as they have done, and wrote about it for ever, and never have found upon what foundation the truth of the matter existed; and here, as in the first place, it may not be improper as in particular to remark, that Mr Huggens was, in his conjecture, a great deal wrong; and my friend Dr Smith (Master of Trinity College, Cambridge) not knowing that I had had any thing to do in the matter, though he and I had been pretty intimately acquainted for two years, and had known each other much longer, and as Mr Graham afterwards told me, that he (the Doctor) had then had his book, viz. upon this subject the scale of musick then under hand for longer than that time; but as finding reason to think, viz. as from or upon an accidental conference which happened betwixt him and me, that I was in the right, said, that he would drop his book, and that I might make the best of mine, but instead of that, did some time after, alter (viz. rather perhaps than to lose his labour) from what he had grounded his work upon, and so as to come near to me, as he himself afterwards told me demonstration would let him, and then published it; whenas it is certain, that if he had not happened to have conversed with me about the matter, he had printed his book upon his first ground or principle, and had then been demonstratively sure of its being right, whenas it was far from being so, though not so far as Mr Huggen's conjecture was before him; and it is certain that neither theory, demonstration, nor algebraical reasoning can have any thing to do in the matter, his own proceeding being even a proof to the contrary, for had such in the case been fact, why did he alter? or rather, how could he have found room or occasion to have altered? And as still farther to remain a little wrong, notwithstanding his alteration or amendment; and as moreover to express what passed betwixt him and me, in his Preface to his book, much wrong, instead of his being pleased that there was, or is indeed, a firm and true foundation of musick; but that, or all this, was not the worst jarr that happened betwixt him and me, for, as I could not adhere to him in the case, he afterwards turned from being my friend in the longitude affair, to his being therein no better than an enemy, and perhaps (as already hinted) in fearing that he should through me lose his labour, or that his book should become of low

esteem, viz. from my foundation or discovery of the scale of musick, as being indeed the only right one, and should therefore as in consequence be stronger than his; <sup>35</sup> for indeed, his neither is, nor can be, any better than as an arbitrary conclusion, for, as touching melody, the chief matter, it will not afford a tune, when strictly put in execution, to any right or true content; neither, as touching harmony, will the fine chords, the sharp 6<sup>ths</sup> and flat 3<sup>ds</sup>, rightly bear with his division or allotment (this is meaning after his alteration) whatever he might judge in either respect from mean or false experiments to the contrary, and his saying as near as demonstration would let him; the whole matter (as I have verified, and can at any time verify) being as otherwise established by providence, for I am very sure (and was then) from the most strict experience that can possibly be made or had, that my foundation is true, and that it is impossible (from the nature and niceness of the subject) for any thing else in the world to define the matter; nay, besides myself, it has been allowed or attested by several musical gentlemen, organists, &c. who heard the result (of, or upon which it is grounded) to be in reality perfection itself, whenas he (the Doctor) was so obstinate in the matter as not to be prevailed upon - by all the inviting, or entreating speeches that I could make, to come and hear it! viz. after I had sufficiently provided for proving the truth of the thing! (viz. more sufficiently than what I had done from the first!) And indeed, the chief head or consequence in the scale of musick, viz. the intervals of melody, are, as I may assert them truly sweet, or mathematically perfect, though never before were thought to be so, or that there was such a field in nature as wherein they could be so, but a foolish imagination sure! Since a good voice never fails, but can always, and without any difficulty, turn off a tune, or even a piece of a tune, truly, viz. as without any regard to the key, as hath been foolishly advanced, and as even by Dr Smith could not be; nor indeed could it be, if the perfection of the intervals of melody were as the musical part of the mathematicians have thought they would be best, could they be so had or admitted; as for instance, was the perfection of the 5<sup>th</sup> (as an interval of melody) to be as 3 to 2 exact, the thing (objection or supposition) would be right, but, as so, a good voice never yet took it, nor never will nor can, because, if it did, it would be very unpleasant, or even ugly, viz. too wide considerably, <sup>36</sup> or as more especially to be notified, the 4<sup>th</sup> to be taken by the voice, or by voices quite out of tune wide, viz. as with regard to harmony, or to the harmony of 4 to 3 (it not bearing in that respect so much as the 5<sup>th</sup>) and whenas true melody requires it so to be, and to which the voice naturally adheres, yea if it wanted to take no more than as only the interval of one single 4<sup>th</sup>, <sup>37</sup> and still again, as with respect to harmony, (viz. as

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<sup>35</sup>So he seemed, as it were, determined to keep me weak, if he could.

<sup>36</sup> But then (as in supposing that the case) the out-of-tune ugliness or unpleasantness (I am speaking as with respect to the melody) would be judged, as according to the common notion of the world (and that for want of accurate experiments in the affair) to be as then, from its not being exactly as 3 to 2, but wider.

<sup>37</sup> And here it may be notified, that four 4<sup>ths</sup> and a sharp 3<sup>rd</sup>, each in the state nonsensically stiled perfect, will not make two octaves, no, not by a great deal; whenas four natural 4<sup>ths</sup>, and a natural sharp 3<sup>rd</sup>, both must and will exactly do it.

in that extreme sharp state) to what amazing fineness it is when the sharp 6<sup>th</sup> (viz. as when also in its respective properness of latitude sharp) is sounded contemporaneous with it, as I can now at any time, and in each of these respects, certify from instrumental experience, viz. to any who may be proper to hear the same, and as thence consequently produce a proof, that there cannot be in the scale of musick, or that the voice can never have any thing to do with such chimerical notes or intervals, as tones major and minor imagined of old; so the symmetry therefore as implied, of all the true intervals of melody, and as must in consequence thereof be also of the most rational, or graceful chords of harmony, can have nothing to do with such arbitrary conjectures as have been advanced (viz. as according to Holder's harmonical nonsense in the affair; surfeiting stuff sure! though he speaks of it with great admiration) but are on the contrary, and as I have verified from due experience, secretly grounded upon the true relation, or as strictly touching this matter, may be said amazing proportion which the diameter and radius of a circle bear respectively to the circumference; viz. as thus, as the diameter and radius of a circle bear respectively to the circumference; so do the sharp 3<sup>rd</sup>, and as here properly speaking, larger note bear respectively to the octave (no tones major and minor being in nature, as of old imagined) and from whence all the others are generated, have you as many keys, viz. by flats and sharps, as you please; <sup>38</sup> I say, as thence in the whole, (and that as from the most strict experience, viz. as by or from the most strictly due apparatuses to the purpose,) are generated to a mathematical degree of sweetness, if I may so term it, as well as to be to a surprizing mathematical degree in proportion, as being seemingly from a thing quite foreign to the matter, yet still a wonderfully strong, and stable foundation indeed! But certainly, as the works of God are in all respects perfect, so his praise, so far as may ever be in relation to this (not meaning the play-house) must require to be so too; <sup>39</sup> but still, so long as the foundation of

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<sup>38</sup> But here it may be noted, that there can be no occasion for so many flats and sharps in an organ for a church, viz. any farther than for what key the whimsies of the organists may want to play their voluntaries, &c. in, viz. things that need not to be played there at all; time, in divine service, being to be otherwise employed, and that, as not only more suitably, but even as more takingly to the purpose so to be done: But indeed, a more suitable construction of the organ must be highly necessary, or else, a consort of good psalm-singers must ever be disobliged by it, or not come there, or to where it is at all, since their performances as thence, could but seldom be as it were truly genuine, or naturally good; \* {but notwithstanding

*\*And I should have thought this ought, as so highly necessary for good psalmody in a church, to have been Dr Smith's study (as a parson) rather than the extravagancy of so many keys.*

but notwithstanding as in, or as with respect to that case, as such the said performances are not as now to be heard, neither to be remembered, they, viz. the congregations, with the charity children, and in their paltry piece-meal, hodge-podge manner, can bawl or squawl away along with the organ, as if such the said children were the most proper instruments, or assistants, for, or to the purpose, and are sometimes set at such a pitch, with, or by the organ (although but one part sung) as to be even fit to split one's head (an absurdity sure) yet still I say, to be as so thought the most proper; but 'tis not so thought to be the case at the play-house, viz. as with children there; but certainly, God almighty never intended that such the latter should ever excel or over-set the former.

<sup>39</sup> And to which purpose it must be, that in or from his completion of humane voices, they do not want as I have shewn, to take or make use of such nonsensically perfect intervals as have been so weakly or foolishly imagined; for certainly, any one note, whenever taken in any tune or lesson of musick, and that whether by the voice

musick lay hid in secret, unknown of to the world, as also the knowledge of any such nice preparations or ways of proceeding as might or must be required, in or for its verification, *i.e.* so as whereby to know whether it was or was not, or might at any time, really be discovered or not, *viz.* whenever, or if ever that was, or could be so deemed as likely to be the case; but I say, so long as it lay hid, the consequence was, that it did not seem to have any absolute or real foundation at all; for, as in the musical part of the mathematicians, finding in computation, or in that they called theory, a defect of what they denominated a comma, and to be as a thing unavoidable in the matter, they thought that the beauty, or perfection of musick, must in some measure be as thereby lost or prevented; whenas, it is through the same that it is indeed musick, and that to perfection, yea far surpassing our imagination, as from the whole of this description is manifestly to be perceived, and consequently the world to be but little obliged to philosophy here, *viz.* in condemning the perfection of the thing, or the wisdom of God therein; but however, they wanted to cloke that deficiency (as they thought it to be) as much as they could, as thinking that it was, or must be always in some measure, nay in great measure, so done by (or that it permitted so to be done by) or else the thing (save only as hereafter through mistake upon the violin and violoncello) could not be so fine or taking as it was, *viz.* to be cloked by various distributions of such and such parts of the said comma, to such and such chords of harmony, and, as at the same time, without knowing what portion of which, each chord respectively, as touching the matter, would bear; nay thought indeed, that such and such a chord as with respect to harmony (not regarding, or notifying what might belong to melody, altho' the chief) would bear the most (or the greatest share in that defect, as was thought to be the case by Dr Smith, *viz.* before he conversed with me) whenas the which in reality (or as on the contrary, under that supposition) will but bear the least. Strange conjecturing sure! as being in consequence without any suitable experience to the purpose! and yet to prevail through ages! and as moreover, with the respective bearing of the sharp 3<sup>rd</sup>, or the result of that as with respect to melody (or as even to the destruction of melody) quite the contrary way, *viz.* sharp instead of flat! But indeed the most part took it from the rest for granted, as so and so to be, *viz.* without thinking, or properly experiencing the matters at all; nay indeed to make experiments, as thoroughly to the purpose, was quite out of the way or power of any of them (or of all the learning or knowledge heretofore in the world); but to proceed, and though ever so far beyond our reason, I do again certify, nay avouch and affirm, and that as without any notice at all of the feigned term of a comma, that the intervals of melody (the principal matter) are from the circle, &c. as here above advanced, turned off exactly true or strictly perfect, *i.e.* as without any the least bearing,

(..continued)

or upon an instrument, ought always to be exactly at the same pitch as with respect to the rest, whenas, if such weakness as intimated could take place, that would not be, nor consequently musick to have any scale at all; but still, for the sake as it were of such as that, it all along hitherto so happened, that violence, as with respect to natural harmony, was in some measure put (as thought for the better) to prey upon nature in tuning the organ, &c. And whenas or as when, what was done for the best, was with quite a contrary drift thereto, the whole being thereby for the worse affected, and that as not in a very small degree, and yet the great Mr Handel among the rest (as not discovering the matter) had his organ and harpsichord so tuned.

defect or infringement at all, viz. as with respect to the most true, or natural steps of any tune; whenas on the contrary, in the taking a few of them (viz. by a true constructed monochord) according to what we should think would, or ought to be perfect (I say a few of them, for all cannot so be) each such one in itself, as with respect to melody, will then have such a bearing, or be so untrue or out of tune, as not to be bore withal, yea so, besides the utter destruction of all the rest; hence if the tuning of an instrument, but as most to be notified the tuning of an organ, be false, or varied from the result of the circle as I have shewn (as indeed it has hitherto all along been, and that in a pretty great degree, excepting through me, as of late, that some tuners have altered) it is not at least fit for a psalm-tune or anthem; for I am very sure, that in its differing therefrom it cannot afford a tune any more or better than a viol, &c. otherwise fretted can do, and that is as nothing to the purpose, viz. in either anthem, psalm, or song tune; but still, as without proof, assistance, or application of a perfect monochord, <sup>40</sup>viz. of such a one as I have constructed, and divided upon the true foundation here shewn; or rather as the more easy, or as the most conveniently to be done, viz. as by the help of a proper set of forks tuned the most strictly to such a monochord, for by which, the said forks or each fork can be tuned to the thousandth part of a note or less; <sup>41</sup> and I think, that by a proper use of fire, viz. at a proper distance from the organ, and as thence by means of a thermometer near, or not far from the organ, that the same may be kept to the degree of temperate heat (viz. to 55) for during such a time as may be required for tuning, by the forks (meaning the same to be a sufficient large size for the purpose) all the pipes included in an octave, viz. in what is called the principal; or at least so long, as by proper or due management of the fire (as from strictly observing the thermometer) as that some of them, as in chief, may be so truly tuned, viz. so as whence or whereby to be checks upon such other proceeding or proceedings as may be thought necessary, or more expedient to the purpose; <sup>42</sup> but I say, that, as without something in this way, it must be a very difficult matter to have it right, or exactly tuned, yea though what is here above treated of be the very voice of nature, it not being to be expected, was there nothing else in the matter, but that variations, or falseness, must arise or happen in the proceeding by 5<sup>ths</sup>, as according to Dr Smith; but the Doctor says in his book, that the voice part of an anthem ought not to be played upon the organ, whenas, I should think it the most material, or else it must be very immaterial to have an organ in a church, and there for a psalm-tune, the which requires the greatest truth of all; but however, be it as it will, our organists generally there take care to blind imperfections with such stuff as does not at all belong to the matter; but

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<sup>40</sup>Nay, as for this purpose or all true purposes, there must as in the first place be two monochords, in order as whence, by proper means or trials to prove the truth of the string, or of each string.

<sup>41</sup>Nay, if a set of forks so tuned could be properly, or duly struck, how sweetly would they play a psalm-tune - slowly; nay if in two, three, or parts, nothing in the world to beat them; a monochord or monochords, as under the same, or such-like circumstances, to be excepted.

<sup>42</sup>And by the said forks (viz. of a lesser size) the harpsichord and spinet can also be so truly tuned, that some players, as well as others, have said, that they never did hear the harpsichord, &c. before.

certainly a tune ought, as in the first place, to be distinctly a tune, and consequently, in a special manner, far from such nonsense as is usually played before they begin to sing, viz. as from whence, but hardly to be known what tune they are to sing, and therefore it would be much better if imperfections did not want blinding, or to be blinded! But indeed the psalms in general, upon other accounts (viz. for want of better discipline than what there is, and in which defect the parsons are much in fault) are no better than smothered, as will fairly appear when I publish the treatise which I have, as more particularly, drawn up about the scale and use of musick, as therein unveiling that abuse or obscurity! <sup>43</sup> But to

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<sup>43</sup> Viz. if, as according to royal David's declarations, as touching his deliverances, as also of them of the Israelites out of Egypt, as well as others the works of almighty God, his dispensations, &c. and as with praises, &c. thereunto pertaining, as in the psalms, be as still to be had in remembrance or veneration, and that as by the words or lines of the psalms to be (as now in the new version) right duly handled, and as therein implying, for the most part, by the going on in succession, with proper portions or divisions of each, or any psalm in hand, viz. as when as so to be done, or as so to be permitted by the parsons, viz. from a skilful delivery of the Clerk (meaning the same as then, to be as fitly chosen for the purpose, as if it was for a play-house), *i.e.* if their dignity (viz. that of the priests) will so admit it; \* {and whenas ...

*\*I say their dignity, not thinking the Clerk to take any of their business from off their hands; notwithstanding, singing men and boys in cathedrals have surplices: but as a tenor to this, Dr Smith (upon our discoursing) said to me, that they could send us parsons, but where must we get good Clerks? And indeed, to have a good Clerk, must, in great part, be as a gift of providence, whenas the other is only as it were from learning.*

and whenas if not, they ought, and as with a suitable grace (or affinity to the tune, as well as at the same time, by proper accents, &c. to enhance the nature of the psalm) to do it themselves, but perhaps they might think it to be as a thing almost repugnant to their preaching; but, no matter for that, they ought not to think it so, but otherwise, and that as truly becoming thereto, viz. to be, as it were, with lower thought - but higher esteem, consequently without any the least pride in the matter, so that as thence, according to their drifts (viz. the whole sacred drift, scope, or meaning of each psalm) as from their contents, &c. as the which contents ought indeed to be, and that as to a full intelligence, at the head of each psalm, that so the same might, as at least with reason, vie with the musick, and that, as the most highly becoming such, that same part of divine service, as therein to do, or rather, as in other words, as the most highly fitting for such the highest part of the said divine service, and as under the Gospel's dispensation to be handled, or so as to be for the better regarded; \* {no notes ...

*\*Not meaning the lines of the 148<sup>th</sup> and 149<sup>th</sup> psalms, nor them of the latter end of every verse of the 136<sup>th</sup>, to be given out; neither do we sing the old 148<sup>th</sup> tune, nor old 113<sup>th</sup>, such tunes, besides several others as of old, being very unsuitable to the purpose; neither as farther, do we use the 100<sup>th</sup> psalm tune for any psalm but the 100<sup>th</sup>, having tunes enough to suit all other psalms, and their measures, as in the new version (and as not over-looking therein the 96<sup>th</sup> and 87<sup>th</sup>, but for which psalms to have fine and suitable tunes) and indeed it is fitting the 100<sup>th</sup> should have a tune to itself, and none can suit it better than its old tune, viz. as when sung eloquently or laudably, *i.e.* as when at a truly right or natural pitch, with good strength of voices - in four parts rightly adapted.*

no notes withal being to be played (or in anywise to be found) but what the voices sing, excepting the octave below the bass; no repugnancy of thorough bass nonsense to be used in psalm-singing. I speak from due experience, \* {and if ...

*\*That being no other, as with respect to psalmody, and as I have seen fairly tried by a company of singers, than as the Devil's invention, for they esteemed it as no better, as being, with regard to them, a debar to any beauty in the matter.*

(..continued)

and if at any time, any of the three or four notes, the which the voices may sometimes sing, cannot be reached or touched upon the organ, such an omission would be no fault at all, because the voices may, or can, do so well without it; or if, instead of playing so many parts, they touch (at least in the tenor) all the notes which voices sometimes, or in some places use, as in their passing from one note to another, *i.e.* to act or do in that point as according to nature, and as letting the upper parts to be sung by the voices only, and as when in them, for a verse or more, as best to suit the matter, or subject matter in hand (and as to be instructed before-hand by the Clerk) the treble to be wholly omitted; I say in this manner the thing would be much better, or they might do or act much better than to affect the making such a strange confused noise, so foreign to the matter, as they always do, and therefore, as in consequence of which (or of the whole I have shewn) not the subject to remain, as under disguise, a mere nothing, \* {but that ...

*\*Viz. as by the taking for singing (to the praise and glory of God) here and there three or four verses, in a nonsensical manner, as to be without any right drift or reason, and as so, no matter in what version, because, for such a going on, Dr Brady and Mr Tate need not to have made a new one, nor needs any parish (deficient in the matter) ever to chuse it, but as still to their shame keep on; I say as still to their shame, for it must be certain that such a proceeding can for the most part signify nothing, save only for the making of a noise, or sham with the organ, and as thence putting as it were a slur on David, just as if a psalm, though ever so well handled, must or could but be, as with respect to a sermon, nothing! But as notwithstanding such impertinancy, as with regard to the royal psalmist, it may perhaps serve (as according to the paltry meaning of such a drift) to make the parson to go up somewhat more brisk or chearful into the pulpit, &c. and as when it cannot be said, that there is, or can be now, quite so much occasion here for preaching, as when St Paul, &c. had to convert the world from such heathenism as was grown upon it, and whenas the praising of God (that everlasting Gospel) is to hold to eternity, and according to St John, they sing the song of Moses in Heaven, as not being out of fashion there.*

but that, as on the contrary by custom, the commendable matter here imply'd to be rendered familiar, as the same, (viz. custom) has done the badness of the play-house: For a psalm, when at so low a degree as to be taken or handled as nothing, must be nothing; and who can say the case is now any better? Well may the play-house prevail, or even the buzzing things in the street! Wherefore I say, if such as this, or the contents of this, be to be regarded more than a play, then it is certain that the smothering, as here above signified, will by my writing be unveiled: But if the case here be not reasoned aright, then David, who was a type of Christ, must be inferior to a priest; for as farther, if Christ in the main contradicted David (viz. as touching the substance of his psalmody, as with respect to religion) they could not both be as according to that same spirit of God, which was yesterday, today, and must be the same forever; but as in consequence, if so, the best way would be to give religion over; but still, even from philosophy, God almighty ought to be praised, or highly praised for his works (yea, assuredly as from astronomy, stupendious works indeed); consequently, if David's motives and ways be not sufficient, so as whereby to keep up his praise, there ought as then to be others taken: But as in supposing it to be (as above) reasoned aright, then, as in consequence of which, was this highest piece of worship, as here advanced, and as with proper tunes or compositions once to be right duly performed in churches (viz. as with more proper, taking, or suitable compositions, as well as to be more properly used or handled, than as hitherto common in churches, viz. as to be there performed by some proper choice of men of each parish, and that as to their pleasure without any salaries, yea more to their pleasure than running about in the fields, and as with their having a proper loft or gallery in the church, - as supposing by a company of about fifty young men so situated, not but that some of them may be married men, \* {and as ...

*\*And for which purpose, entire, we had a loft erected.*

and as to be right duly instructed by the Clerk, as I have known, and as whence in the whole, any one of them would almost have thought himself half dead, if he could not have got himself to the church, \* {and as ...

*\*And I am very sure, that had there been an organ, and withal used in such a manner as hitherto used in churches, it would have been impossible in any of our singers, ever for that to have been the case.*

return, Dr Smith says, that the voice-part of an anthem ought not to be played upon the organ: <sup>44</sup> But why does he say so? Why, the reason must be, because he

(..continued)

and as so, together with some boys for the upper parts of such compositions) how wonderfully strange it must be! yea even to where unknown, or unaccustomed thereto, as if they were barbarians to it! The psalms not being as only properly adapted to private meditation or contemplation, were they, as now, in that way to be regarded, but as, in chief, David made use of their subject drifts, and that to the greatest advantage, in public singing; and who can, or dare say, that there is no occasion for any such method, or course, now to be observed or taken, as there was in the royal psalmist's day? But that as on the contrary, the drifts of the psalms, as with respect to singing, to lie as under disguise above. So now, as in the whole, ought it not to be asked or considered, whether it be not a shame that these sacred things should not be more punctually handled, or better regarded, than what they are as now? or whether it was not a shame that David, &c. ever wrote them at all, viz. as in behalf of a public worship? as the which latter, indeed, seems to be - by the parsons, tacitly thought to be the case, or otherwise, one would think that better care would be taken about them, viz. about such divine or sacred precepts, yea even if less care was to be taken about a sermon.

<sup>44</sup> Not that I greatly mind what we call an anthem; but a psalm, viz. with its tune or composition of musick properly adapted (not such composition as according to Mr Handel's taste, of or for a psalm-tune) and so to be pitch'd, as that to exactly suit the voices, and sung in three or four parts by a company of singers as above - what a noble thing it is! But it is to be notified, that a little bit too high or too low in pitch, as the 1-8th part of the larger note, will greatly disoblige the voices (viz. more than one would imagine); I speak from the experience of 20 years, and as with proper instrumental care for pitching; and as in the same time (or long experience) I strictly found or confirmed (as in the time of divine service, or as therein the best to suit) that one tune required to be pitched a little flatter or sharper than another, and as when, without experience, one would have thought that the same pitch might have done right well; nay, and that any one, the same tune, required to be pitch'd a little flatter in the after-noon than in the fore-noon; but still, it must be allowed that good voices for psalmody must have the preference before all other instruments; but then (and as here exhibited) they must require to be exactly humour'd; \* {but that ...

*\*Not knowing how it might be with the Hebrew musick; nor, perhaps if we did, should we be therewith content.*

but that is what the organ cannot do, save only as in here and there a tune, and as at now and then a season to be excepted, and as still with supposing it to be exactly in tune to itself, or that it would keep so exact thereto as to what it might be set, and that they could also touch or play thereon such notes, and only such notes, as the voices sing, or rather as may, to the greatest importance or enhancement, by them be sung; and so, as we had not an organ, neither to help us, nor to hinder us, \* {we had ...

*\*Viz. not, as in the main, - an organ instead of a psalm.*

we had not our tunes pitch'd according to the fixed notes of an organ, nor of any other instrument, but as only from an instrument whose pitch might be set exactly to where it was at any time to be required, and the which (as from properly small divisions upon it) I noted, as from experience, to each tune respectively, \* {in order ...

*\*Note, the instrument laid, in its case untouch'd, save only for just the time or times of its using.*

in order that we might not, in the least, be ever disobliged on that account, viz. by being at all either too flat or too sharp: And it here it may be worthy remark, that an organist, who was out of place, came on purpose to hear our singing three different Sundays, and attended the church both fore-noon and after-noon, and said (or owned) that it was impossible for a psalm (or the psalms) to be so well handled by any instrumental musick whatever, and wondered how the singers (the which consisted of plough-men, shoe-makers, carpenters, smiths, taylors, weavers, &c. and as with some boys, singing with their voices small, for the treble or highest part, and with only two boys at full strength for the contra-part, viz. in such tunes as we used such a part) could ever be brought to such perfection; for, the first time he heard them, and upon the very first note, he was quite astonished: \* {Now I ...

*\*And here it may be notified, that nothing can be more handsome than for the parson to sing bass along with the*

never found it to be rightly in tune (or to agree with what the voice and ear wanted it to be; I am not speaking here about pitch), whenas I am sure it can be so, or may be so, viz. if consisting only of such stops as may be said to be rightly proper for the purpose, (consequently, not such stops, or musick thereon to be played, as to be even repugnant to the design or nature of psalmody) <sup>45</sup> but still indeed, to have it exactly so, nothing more nice in the world! <sup>46</sup> And besides, or as without the foundation of the true or perfect intervals of melody, as here spoken of (and as ought certainly to be, nay must as in consequence be, the chief, or primary matter), it would have been a thing quite impossible, as with respect to consonancy, ever to have brought the respective bearings (as denominated of the chords) to such and such their most proper or respective distances or latitudes, viz. from each such ratio, as from which respectively they may be said to be generated (or, as unqualified thence to issue); and so as whence, not only to become as in the first place, and as already avouched, true intervals of melody, but also, as at the same time, viz. from each, as it were their then correspondent seasonings to afford the most lofty, or the most elegant degrees of harmony; yea so I say, as touching this latter point, as well as the other, and the which as otherwise would never have been possible ever to have been brought to a true decision! whenas from the circumference, diameter, and radius of a circle, that matter is withal undoubtedly, nay I am very sure undeniably, decided, the chords having as thence, or from their allotment exactly as thence, (viz. no one respectively to be in the least degree either flatter or sharper than as so allotted) they have, I say, as thence, a much better relish, or a more lofty warbling, viz. in tunes or lessons of musick, than if they could be had from what has been thought would be perfect; but still, it is to be understood, that to tune an organ, &c. only by the harmony of the chords, viz. as without any other assistance (and although the common method hitherto practised) must be quite insufficient for the matter of exactness, or as a beginning  
 (..continued)

*singers (and not to sit gazing about him, as knowing nothing of the matter); neither will it hurt or strain his voice: As also, here and there a man in the congregation who cannot sing tenor.*

Now I could instance of other gentlemen - strangers to us, besides this organist, who were also taken with our singing, but I will only here mention one, who, after the evening service, was pleased to give the singers a treat, and that because, neither at St Paul's, the King's Chapel Royal, nor at the play-house, had he ever heard the like, though he had oft times frequented them places; and he also admired the decency of our singers, all standing when singing (facing the congregation) with their basses in the front, and in the next pews the tenors, &c. and the trebles up behind; yea certainly a finer, or a more graceful sight, than to see our gentry at the play-house - a sight never designed by the dispensation of Providence; consequently, never (as a ceremony) for any pretended psalmody - there to be sung in Lent.

<sup>45</sup>No, such deficiency, and as hath been shewn in more respects than that, surely wanting as great a regularity, as was instrumentally wanted in mensuration of the time for the longitude.

<sup>46</sup> Each interval of melody requiring, if possible, to be even to a mathematical point of exactness, and the same to be from, or accordingly (as I will once again affirm) to the result of the circumference, diameter, and radius of a circle, for I am very sure that no other points or stations will truly afford a tune; a most surprizing, stupendious matter indeed! Consequently, such stops as they call 10<sup>th</sup> and 12<sup>th</sup> (if tuned as they denominate perfect) can have nothing to do with psalmody, nor rightly with any thing, save only so as whereby to help the organist to make a vast great, confused noise.

at the wrong end of the work, and that for want of a more proper means so as whereby to set out the steps, or to gauge the matters more exactly, since as thence by a good tuner, and as without such a proper gauging, all the chords may seemingly be had or obtained to what they ought to be, and as when at the same time not the true intervals of tune; the intervals of melody being in themselves much more nice or delicate than the consonances of harmony! As for instance, the 5<sup>th</sup> upon an instrument, may, as a single consonance, be thought to be very fine (nay is indeed the most fine) when there set or taken exactly as 3 to 2, although voices never take it so (nor can ever take it so, that being only a foolish imagination, and quite out of the course of nature), and it may be thought to be good (viz. upon a spinet, &c.) when any where taken betwixt that and the flat latitude, at which it is as only, or as rightly to perfection to be admitted, viz. as with regard to its mathematical point, or points of melody; and the same may be said of all the rest, *i.e.* as strictly touching their flat or sharp latitudes respectively, viz. from what has been thought would be perfect (could such have had their admittance); consequently, it must be the true intervals of tune, or, as in other words, the true stepp'd passages among the different parts of melody (though not to be fathomed by our reason) that gives to harmony its true or fineness of relish, yea so, as well as to melody in itself, as in a single part tune, or solo; <sup>47</sup> and as so, or that that should be the case, what ought therefore, as once again, to be said of the foundation or existence of the natural notes, or intervals of melody? and to what chief purpose must the same, as thence, be said to be? But Dr Smith speaks of perfection being in the violin and violoncello, as if upon them (at random) the inconsistency, as hath been shewn, could be so truly humoured, as whereby the chords and intervals to be rendered perfect (viz. as accordingly to what has foolishly been so styled), whenas, it is only their sort of sound (or, as in part, surge) that is indeed excellent, or even very excellent, for concealing of faults in quick musick; a famous property indeed! And as when at the same time (as without fretts duly placed, viz. as according to the foundation from the circle as here advanced, and the farther consequence of the truth of the strings, as to be acquired therefrom, and to be corrected, if or when occasion) there can be no real perfection in them, no humouring to be in the case (excepting as when, in a long note, they hear it wrong, and flip their finger a little to make it better) for (as above) it is certain, that (as well as by the voice) any one note whatever, when taken in any tune, ought always to be at exactly the same pitch as with respect to the rest, or else (and still as above) no scale of musick at all; and it is not possible, as pursuant to what has been said, that the fingers can stop at all the sundry places at which they are, or ought at any time, to stop, and especially so, as with regard to their

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<sup>47</sup> A meat pie (as here by the by) will not be good, truly sweet, or relishing, without some pepper and salt: Nay, in a peal of five bells, *i.e.* where there is but one 5<sup>th</sup>, it, viz. that 5<sup>th</sup>, although seemingly under no restriction of being any otherwise than as what we should think would be truly perfect, yet will not be right truly sweet, unless it be no wider, but exactly according to the result of the circle as above, as I the most strictly know from experience, viz. by such means as by which, indeed, it was right truly to be known; consequently, as even from thence alone, was there nothing else, a full proof is had (as was also by my apparatus, testified by others as well as by me), viz. of what wrong imaginations about the matter there has all along been, or prevailed, in the world! the true foundation of musick being unknown; but as on the contrary, divers opinion and nonsense about it.

playing in different keys, viz. so near hardly as to the 20th part of an inch, whenas to perfection, much nearer, nay very much nearer than so, is, or must be required, and as most especially upon the violin, where the strings are but short; or otherwise, and as chiefly touching any sort of psalmody, as an anthem, &c. there can be no such perfection in them as Dr Smith seems, from these sort of instruments, without fretts, to maintain;<sup>48</sup> but even without any farther to say, it

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<sup>48</sup> For supposing a psalm-tune (viz. its tenor and bass) to be played slowly upon them, and never in the least, at any time, to flip the finger (or any finger) from where at first stopp'd down, or pitch'd, what a bad piece of work would be made! For even, without fretts, they cannot (as above) right truly set their open notes as 5<sup>th</sup> in tune, a 5<sup>th</sup>, as a single consonance, and chiefly upon them instruments, being good anywhere, viz. betwixt and including where it is falsely said to be perfect, and the flat latitude at which in tunes, or lessons of musick, it only as so, can be said to be; not but that they may set them truer (viz. the open notes as 5<sup>th</sup>) than they can always stop other notes (the hand having withal sometimes a great way to shift) but I am reasoning about perfection; and towards which (the said perfection) in tuning by the use of fretts, mathematically placed, and as according to the result of the circumference, diameter, &c. of a circle, and as thence on course, or as a very material matter in the affair, the true or certain distance of the whole length of the strings, viz. from the nut to the foreside of the top of the bridge, to be, as by a lath or gauge, the most strictly kept or observed, \* {and as ...

*\*Now this is not to be done by hauling the whole bridge at once, but as by discreetly jerking or pinching, at the bridge, string by string.*

and as together with such proper dentings or small lengthenings respectively of the strings into the nut (in the first string excepted) the whole length of a thick string not being rightly concerned in sounding close up to the nut (meaning as from the thickness of the gut, viz. as without notifying when stretched, the wire upon it, as in a covered string) but that a little bit of it, from its stiffness and lying fast in the notch, will still as it were remain at rest, or not (as again) be fairly concerned in sounding; but, from the softness of the fingers, that is not the case at the fretts; I say as thus, and as together with Captain Bentinck's screws; for indeed, without such screws, such experiments upon them instruments, as I am here about to speak of, could not well be tried, whenas, as only then, in the making use of the larger note, or third frett from the nut, the strings in the first place being made correct (no easy matter to be done by the musicians, at least at present, as being as it were quite foreign to them; but I am still treating about perfection) a touch or trial of the sharp 6<sup>th</sup> (the which, as a single consonance, must be as sharp as the ear will permit) as also of the 4<sup>th</sup> (the which must as still be sharper, or as rather, with respect to consonancy out of tune, wide or sharp) will greatly rectify, or decide the matter, viz. about the open 5<sup>th</sup>, &c. nay, as not amiss, a touch of the first and fourth strings with the bow under the strings, will, as a sharp 6<sup>th</sup>, (compound of the octave) as sharp or wide as ever the ear will permit - give some confirmation to the whole; nay sometimes by these, a small fault, or faults in the strings, if towards, or near the nut end, may, when skilled in the matter be discovered; and even as hence, it is withal (as farther) sufficiently proved, that what Dr Smith asserts, as touching the scale of musick, is not right; \* {for, in his ...

*\*But indeed, if a man be notable, or cannot be as highly master in this concern, viz. so as to make, and prove his strings to be, right truly in order, he cannot make this (most highly good) experiment; neither others, as belonging to the same purpose, and as also to be, in the first place, as the most highly necessary.*

for, in his making (or supposing) the 5<sup>th</sup> to be wider, and as also (on course) the whole note (as they call it) wider, must, as in consequence, spoil the sharp 6<sup>th</sup>, because as thence, it must become wider or sharper than what it will bear; now these are indeed very material matters, and that besides the other proofs or truths which the fretts will afford; but still, as overlooking all this, or such as this, (as indeed, heretofore unknown or unthought of, but that as on the contrary, being biassed or prejudiced, through false or foolish conjectures, viz. as touching what was done, or might be done) these instruments, the violin and violoncello (notwithstanding deficiency) were, and still are said, and as without fretts, to be perfect; whenas it must be, that faults by their voices are cloked or concealed. But here it may be proper to notify, that a viol (viz. with six strings), to any who may have a capacity to put it in order, or can be instructed to know what must belong to that, and consequently to keep it so, or always to have, or make it so, will then afford (as in itself, and as so - the King of Instruments) the greatest proof of all, of what is the real scale of

is certain that there must be greater faults embraced there, than could be put up with upon the organ, harpsichord, or spinet; a famous qualification indeed in them sort of instruments, as here above advanced! And as very surprizing on the other hand, what ought there to be said of the infamous or monstrous division, by the use of fretts, as now in common upon the guitars? For certainly the improvement of screw-work for the open notes, cannot in the least do anything towards mediating or bettering the badness of the scale, or rudeness of the division thereupon used! viz. the same which was foolishly, and for a long time, used upon the viols and lutes, <sup>49</sup> but that there must be, as now again, as well as were then for all the while, - infamous masters indeed, viz. for the greatly abusing of musick; for now, from the pretty voice of the guitar, viz. in its clokeing such stuff as can have nothing to do in the matter, no, far from it, and though in that point (viz. clokeing) much better than the viol, &c. could do, yet still as with respect to musick (viz. in the condition intimated) there can but be as it were a fine sort of janglement turned off, for, was a psalm-tune or an anthem to be played upon it (be such to be notified) the beauty of holiness (as according to the royal psalmist) must, in praising of God that way, be very much defaced, true melody and harmony being - both as thence sacrificed, viz. to the absurdity from, or by which the fretts are placed; and yet to this, ladies of quality must sing! But what must they sing? Why, a shame to themselves and their masters! because it can play nothing else! - but now to proceed, (the last piece as here above treated, viz. as about the guitar, being as it were almost a digression, and but hardly worthy notice, but I say,) it ought certainly, as in a high degree, to be remarked, that Dr Smith's endeavours, whereby to find the bearings of each chord, viz. by the number of beats respectively in any given time, and as thence to tune the organ exactly - could be nothing, but were pretty much a-kin to the finding the longitude by the moon; <sup>50</sup> for, as nothing to the purpose could be had that way, so, in his tuning an organ, harpsichord or spinet, and as not being on the other hand by an accurate monochord, founded, upon what he calls his own principle, neither as upon that of mine, how could he tell what was done, viz. as touching any strictness or truth in either of them? <sup>51</sup> But as notwithstanding, whatever university men write or do, it must be had in veneration, as was the case with Mr Huggens's

(..continued)

musick! although an instrument, now - of low esteem, nor was it ever worth any thing at all, for during all the while - the which it was in vogue; but I shall not here treat about its qualifications to the purpose, for that would be, as here too long: But I may here notify, or certify, that an organist who, upon hearing me play some tunes upon my viol, owned that it spoke to perfection itself; and whenas, without a monochord, a spinet or harpsichord can give no such proof to the matter, viz. of what is the true, or real scale of musick - as the viol in itself can do.

<sup>49</sup>Viz. the octave into twelve equal parts; two of which to the whole note, and one to the half.

<sup>50</sup> Now here it may be proper to notify, that no beatings are to be heard from a viol when truly fretted, or rightly in order, no, nor, if you please, from two viols, playing slowly a psalm-tune and its bass, viz. any more, or no more, than as from human voices; but indeed, not so the case with an organ, neither with musical forks, but still, not to be enumerated.

<sup>51</sup>But a monochord to perfection, to have been produced from Cambridge education, would have been another thing (viz. something very extraordinary indeed).

division as touching the scale of musick; <sup>52</sup> viz. the octave into thirty-one equal parts, whereof five of which was to go to what they call the whole note, and three to what they call the half note major, whenas if an organ, harpsichord, or spinet, was to be tuned exactly thereto, viz. by a monochord well executed, and truly divided or set off upon that principle, *i.e.* each division to be thereupon true to its place, at least to the 200<sup>th</sup> part of  $\frac{1}{4}$  inch, as ought to be the case with a monochord, nay, must to the purpose be so upon my principle (viz. as set off with great accuracy from logarithmical calculations, and as then together with such a string as must still to the purpose be required; <sup>53</sup> or was a viol, &c. to be fretted accordingly as here signified, viz. to what Mr Huggens thought must be the best, they would, viz. any, or each of them respectively, be very confusedly out of tune, viz. more so by far than what Dr Smith had imagined, and as farther upon his own conjectures had made, as he thought, very accurate experiments about; and, as with respect to his book, no doubt but that algebra was made a tool of, or rather (as in its having nothing to do in the matter) a fool of, viz. before he took occasion, through his conversing with me, to alter from what he thought he had ascertained, not meaning that he altered from the algebra, but only in the algebra, so as the better to suit with me; but still, as to his experience or application thereof to an instrument (as already shewn) there could be no proof, either of his principle or mine, or rather, as in other words, no proof at all of what he had brought his principle to, as in comparison, or consequence of mine! And yet to publish upon such a silly, weak foundation, or insufficient, uncertain way of trying, as wherein (for ought he could prove or assure to the contrary) mine might be taken or aimed at, instead of what he calls his own! O fie! Infamous Cambridge craft indeed! Such experience as that, not being able to verify the truth of what he thought, or might think, he had brought the alteration to his book to! <sup>54</sup> for, from his conversing with me, be his book what it will, or whether it had ever been wrote at all or not, or even whether he had ever so much as thought about it at all or not, he might, from that way to work, have done the very same! University ingenuity! Nor can any the best player upon the violin, &c. (viz. as without fretts, or any adjusting, or

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<sup>52</sup> As likewise in his cycloid, viz. as with respect to any application of such his demonstration to the pendulum of a clock, and where it (the said pendulum) must move in the medium of air, and where, consequently, the draught of the wheels of a clock must be concerned; and whenas, even without that (or these matters) it could not, for other reasons which I have given, be as there - for any good applied.

<sup>53</sup> For here I must notify, or rather certify, that none of the common wire (viz. of the spinet wire, &c.) will do for the string of a monochord: No. A string for a monochord is indeed something very extraordinary, and of very great moment, and that as unknown to the world before! But I shall not here treat of its properties or faculties; but however, it is very practicable to be produced, since as now, after my discovery of such unimagined secrets or faults as would pertain thereto, and as not only so, but also how to prevent the same, and render the matter perfect, it is no great difficulty to be had (but still, not that every one will do) as is to be verified from divers sorts of experiments by two monochords, truly perfect in other respects; the old notions of a monochord being even as nothing at all towards the matter.

<sup>54</sup>But, Dr Smith says, that he directed Mr Turner, an organist, so as to put his way of tuning in execution, and that he (viz. Mr Turner) approved of it very much: but here, it must certainly be worthy remark, that it had never been the Doctor's way, had it not been mine first.

correcting of the strings as whence to be verified) ever as thence know what is the real scale of musick; for supposing he could stop, or may stop exactly to, or in such places as at which his ear may best like it, or even, as exactly to what he ought to stop; yet I say, as thence, he can have no mathematical account of the proportions or intervals of the scale, or of what is the scale of musick he makes use of: As for instance, no one, even the best player, could ever tell whether he played the sharp 3<sup>rd</sup> exactly to what is said would be perfect, or whether he played it, as with respect thereto, a little flat or sharp, in order that it really should be so; no, no more than what a good singer as by nature can, and that is as thence or thereby - none at all; consequently, such a performance can have nothing to do with the application of the real scale of musick to the tuning the organ, harpsichord, or spinet. Now, Mr Graham never so much as offered to beset, bespatter, or besiege my proceedings, after any such rate or matter; but, as notwithstanding, Mr Ludlam could: But now, upon my first telling Mr Graham that the Doctor and I could not chime in right about the scale of musick, and that I believed I had lost a good friend as with respect to the longitude affair, he (viz. Mr Graham) was very much displeas'd, and thought that, instead of the Doctor using me ill (viz. as by his taking or setting the accuracy of my labour as nothing) he ought, as an upright, ingenuous man, to have been pleas'd that musick had so good a foundation, and so as to put an end to all disputes and conjectures about the matter, and Lord Macclesfield also expressed the same; however, I kept to my integrity, not minding the loss of a friend, and who I had so great an esteem for, and would very gladly have had him to have taken the matter (as in its true light) quite off my hands (viz. before he published his book, or as even from the first time that we conversed about it) as thinking he had both more time and art than I, viz. so as whereby the more handsomely to communicate both it and it's use to the world; but that he would not do, as pretending (viz. after he had altered his book) that demonstration would not let him, the which, as I have shewn, could be nothing; but as I was certainly in the right, and standing to my integrity I lost his friendship, and indeed it was with tears;<sup>55</sup> but this is the way of the University-men, they want to suck the virtue out of every body's works, and then to call all their own; for through me, he (the Doctor) brought his scale of musick very near to mine, or nearly to the truth, but, as in the main to be taken, left a little difference, that it might be called his, and not mine: Nay, with respect to these sort of men (or University gentlemen) I have smelled a design, of the same sort or kind, upon another discovery of mine - besides this, and that a secret as this; and the which had never been discovered at all, had it not been through some transactions I had with my third machine; consequently as so, and as to be so very weighty, or so highly useful a matter or discovery as it was, and as never to have been known or discovered without it, it was therefore longitude enough for it, and worth all the money and time it cost (nay, it was even withal, as some requital towards the loss or expence of the other two) viz. my curious third machine; and the which, with the other two large machines, was the most scandalously sacrific'd, viz. by a novice, as at, or to his pleasure employ'd - by the Board of Longitude.

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<sup>55</sup>Not that he had any great skill in the matter (viz. of my machinery) but did me good, nay a great deal of good, from what Mr Graham said of it.

Now, Mr Graham allowed that his methods for a nice mensuration of time, were insufficient as with respect to mine; but that was far from being the case with Dr Smith; he was a parson, and they are strange things!

And now I think, that the drawing up of this book, and as together with the drawings and other writings I shall leave (and especially them of late) as illustrating why time-keeping can indeed be so truly had, must, if their virtue can be kindly received --- be better to the public than if I had finished or completed ten longitude time-keepers; no (Lord Morton's) chance to take place in the proceedings: For, towards a proof of which, let it be remembered that I have said in this book, that if it pleased God to continue my life and health a little longer, that then, from my last improvement, I would bring my watch or time-keeper so as to perform to a second in a fortnight; and now, since the drawing up of that part of the book, I have indeed put the major part, but still not the most nice part thereof, viz. of my last improvement, in execution, not venturing, upon serious thought, to attempt the whole, lest I should not live to see it perfected, and I now find the watch to perform as above expressed, nay even to nearer than so! but still no astonishing matter, save only to them (or such philosophers) who cannot be able to weigh its construction, or the main points of its contrivance, and as wherein hardly to be influenced, whether any oil or not: But indeed, had I continued under the hands of the rude Commissioners, this completion, or great accomplishment, neither would, nor could, ever have been obtained; but however, providence otherwise ordered the matter, and I can now boldly say, that if the provision for heat and cold could properly be in the balance itself, as it is in my pendulum, the watch (or my longitude time-keeper) would then perform to a few seconds in a year, yea, to such perfection now are imaginary impossibilities conquered; so the priests at Cambridge and Oxford, &c. may cease their pursuit in the longitude affair, and as otherwise then to occupy their time.

I will now give some account how the real scale of musick is indeed generated from the proportion which the diameter and radius of a circle bear respectively to the circumference; but, as towards which, this great, or secret discovery, it is, as in the first place, to be understood, that it was after I had made several strict experiments of divers, or diverse divisions of the octave, and they as from or by such necessary, or proper preparations, or aparatusses to the purpose, as from my other business I was enabled to make; yea, I may boldly say as thence, from far more correct, or natural qualifications to the purpose, than any before me were ever able to make or have (nay, and still are - as yet the same), and that, as so at last, I found to my great surprize, or admiration (viz. as from the same strictness of trial of the result of the properties of a circle, as here above specified, and as with such, the same aparatusses to the purpose) the real foundation of the matter to exist, or to be, as thence, by the hand of providence established; and the which (as in brief) I shall explain as followeth.

Let the ratio of the octave, or, as even here, as well as below to the purpose, the octave itself, be represented by the logarithm of 2 (viz. by ,30103); and let that same number be also taken or supposed as the circumference of a circle. And then (as in the margin) let the space of quantity of two octaves and a sharp 3<sup>rd</sup> be taken, or be as chiefly, or rather a primarily to the purpose notified, viz. when (as according to my

,30103
<u>2</u>
,60206
<u>,09582</u>
<u>,69788</u>

discovery) the said sharp 3<sup>rd</sup> is in its most strictly musical proportion, and that is as when, with respect to the octave, the same is taken as the diameter of the circle (viz. here, as ,09582): For the proportion which the circumference of a circle bears to the diameter (and as true enough to this purpose, as well as to others) is about as 3,1416 to 1: So, as 3,1416 is to 1, so is ,30103 to ,09582.

And then, as five larger notes (but not with tones major and minor, as hath been imagined, and that from of old) and as together with two of the lesser notes (as all along foolishly styled half notes major) are, or must be, exactly contained in the octave: So therefore, as in taking half the diameter for the larger note, viz. ,04791, as I from strict, or proper experience, found it to be - as an interval of melody, right truly pleasant (although, as barely in itself, as well as the lesser note, nothing to do with harmony), and that four 5<sup>ths</sup>, thence as below to be generated (viz. of each containing,17447), and as when, as I am proof sure, to be then in their most strictly musical proportion, will, as according to nature, be equal to the two octaves and sharp 3<sup>rd</sup>; and at the same time, as already intimated, each one of the four 5<sup>ths</sup> will also be as without any infringement in any case (viz. as with respect to the product of nature) so generated by subtracting five times the radius from the circumference, where will be left such a quantity or space, as the two lesser notes must, with equal shares, take up; and that will be ,06148, so the half of which, viz. ,03074, must be the lesser note; and the lesser note subtracted from the greater will leave ,01717, properly to be called a flat or a sharp (or the difference of the notes), and not nonsensically the half-note minor; the lesser note having withal the same authority to be called a whole note as what the other has; but they may respectively or properly be styled tone major and tone minor, viz. without meaning the fictitious nonsense as of old; and (as well understood) a 5<sup>th</sup> must contain three of the larger notes and one of the lesser (viz. as in the case or cases here, ,17447).

$$\begin{array}{r} .17447 \\ \underline{\quad 4} \\ .69788 \end{array}$$

But as notwithstanding, that from what is here above, are indeed the real steps or intervals of tune, or of natural melody, exactly pointed out, or are to be as thence truly generated (viz. accordingly as they are taken by the voice or by voices); so there must, as in consequence thereof, be also the real consonances, or chords of natural harmony, truly limited or described; nay as so, in both respects (viz. as touching both melody and harmony) I found, to my great surprize, to be confirmed upon strict instrumental musick, as I have shewn above.

But still (and as has just been intimated) that though from what is shewn above, the true steps of melody, as also the true consonances of natural harmony, are, as touching them all, or each of them, exactly to be defined, yet, as from thence, no ratios at all can be said to be (that of the octave to be excepted), so the said chords, &c. must be denominated as they have all along been; and, in the logarithm way, as here to the purpose the best way, as the ratio of any chord is to be had by subtracting the logarithm of the lesser number from that of the greater, so therefore, and as only proper, viz. as in what is here, as first above - may differ from such ratios, so each chord, or interval, must to its properness, or sweetness of relish, in tunes or lessons of musick, be said to have respectively such and such flatness or sharpness of latitude; as the 5<sup>th</sup> to have ,00162 flat latitude, the 4<sup>th</sup> (its complement to the octave) as much sharp; the sharp 3<sup>rd</sup> to have ,00109 flat

latitude, the flat 6<sup>th</sup> as much sharp; the flat 3<sup>rd</sup> to have ,00053 flat latitude, the sharp 6<sup>th</sup> as much sharp; and here I may notify, that the 3<sup>rds</sup> will bear their flat latitudes better than the 6<sup>ths</sup> will bear their sharp; nay, the 5<sup>th</sup> will bear its flat latitude of ,00162 as well or better than the sharp 6<sup>th</sup> its sharp latitude of ,00053: But, to bear have I said, as touching them all! whenas, as when in that, their exactly right degrees, they are only as so rendered perfect! I speak from strictly due experience (viz. from such as no man before me could ever make, nay, and are as still the same); and therefore, as each interval respectively so results from the properties of a circle, as I have shewn, they cannot each one, or any one, as by a proof from thence, be said to have a defect of any part or parts of a foolishly feigned nonsensical comma; no, for this, as here otherwise shewn, is certainly the true essence of all that can be said of the matter, whatever nonsense any book, as heretofore in the world, may consist of.

Now, whether my style of writing in this affair, be right proper to the purpose or not, I thought it must be better than that the contents of this book should be in danger of sleeping in oblivion; yea, notwithstanding what I had - as verbally communicated to the world.

FINIS

## NOTES ON THIS TRANSCRIPTION

This document has been transcribed from a photo-copy of the pamphlet printed in London in 1775 and sold by T.Jones of N<sup>o</sup>. 138, Fetter Lane. The text has been altered by removal of the capital letters and by the correction of the spelling of 'litude' on page 41. All other spellings and the punctuation are as published - as far as I can tell. Andrew King tells me that the published pamphlet is punctuated exactly as the manuscript; I have not confirmed this for myself. The manuscript is currently held by the Library of the National Maritime Museum. The transcription was made as part of the preparations for the tercentenary of Harrison's birth in 1993.

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