The nature of the nervous fluid, or, Animal spirits demonstrated : with an introductory preface ... / by Malcolm Flemyng.

THE NATURE OF THE NERVOUS FLUID, OR ANIMAL SPIRITS, DEMONSTRATED:

WITH AN

INTRODUCTORY PREFACE.

Corpus ipſum ſibi ipſi idem eſt, & ex iiſdem conflatum.—— Corporis pars minima omnia habet, qualia quidem & maxima.

Hippocrat. de Locis.

By *MALCOLM FLEMYNG*, M.D.

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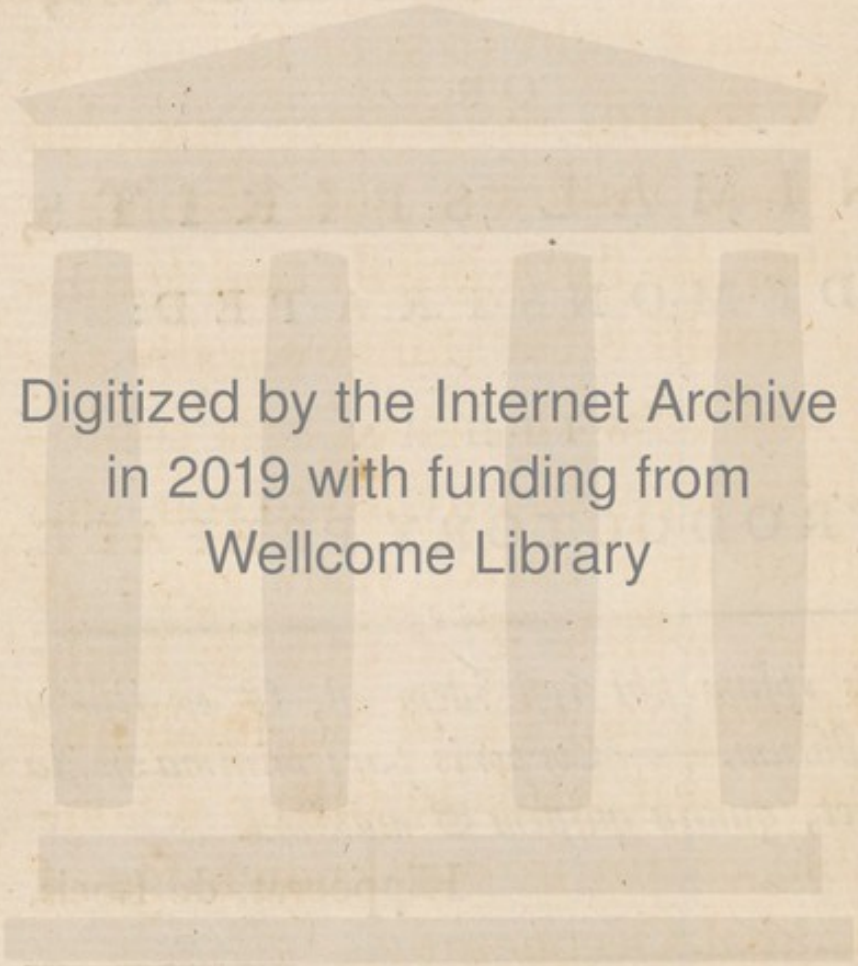

TO

Dr. *PETER SHAW.*

SIR,

THE following pages may plead ſome right to your favour and friendly regard, as they are intended to explain, illuſtrate, and eſtabliſh a Doctrine, ſet forth briefly and tranſiently, amidſt other things equally abſtruſe and intricate, in a *Latin* epiſtolary diſſertation I addreſſed to you, and publiſhed near twelve years ago: A Doctrine, which if it can be fairly maintained, may be of no ſmall importance, as it tends to fill up a conſiderable chaſm in our knowledge of the Animal Oeconomy.

That this Doctrine, ſuch as it is, may become more generally known and attended to, and therefore of courſe more thoroughly tried and canvaſſed,

I have now ſent it into the world ſingle and uneclipſed by other ſubjects that might be more ſhowy, cloathed in an *Engliſh* dreſs, and as clearly explained, and ſtrongly ſupported, as I apprehended was at preſent neceſſary. To anſwer which ends the more effectually, I have inſcribed it anew to you, whom I eſteem and honour, not only as a rare patern, but likewiſe as a zealous encourager and promoter of medical knowledge, and indeed of almoſt every kind of uſeful and commendable learning.

That you may long proſper, and continue to labour ſucceſsfully for the good of mankind, which you have ſo much at heart, is the ardent wiſh of,

SIR,

Your moſt devoted obedient Servant,

Novemb. 16. 1751.

Malcolm Flemyng.

PREFACE.

THAT *the reader may clearly apprehend the ſcope and intent of the following ſhort treatiſe, I have judged it proper to premiſe ſome things, and lay before him the occaſion of my writing it, and my reaſons for publiſhing it at this preſent time.*

In the year, 1740, *I publiſhed a* Latin *Poem on* Hypochondriacal and Hyſterical Diſeaſes, *entitled*, Neuropathia, *uſhered in by a proſe diſcourſe in the form of an epiſtle, addreſſed to Dr.* Shaw, *explaining and enlarging upon ſome points relating to the principal ſubject, which could not be ſo fully and minutely diſcuſſed in a Didactick Poem, where a ſententious conciſeneſs muſt be kept up. In this diſcourſe, after having laid down the exiſtence of a nervous Fluid,*

as a fundamental doctrine, and endeavoured briefly to take off Dr. Cheyne's *objections againſt it, I proceeded next to enquire into the nature and conſtituent parts of that Fluid, in the paſſage which you will find in the orginal* Latin *at the end of this preface; a cloſe tranſlation whereof is as follows:*

" Before I diſmiſs this ſubject, I ſhall " briefly enquire into the nature of the " animal ſpirits. For all the authors I " remember to have read, and my books " are not juſt now at hand, give not ſuf- " ficient ſatisfaction upon this head. On " the contrary, I wonder that an eaſy " and obvious manner of reaſoning did " not come into their minds, to this pur- " poſe; as the animal ſpirits are the fineſt " and moſt ſubtle of all the liquids in " the animal body, the nerves muſt be " nouriſhed ſolely by theſe, it being im- " poſſible for a canal to be nouriſhed and " repaired by a Fluid which is too groſs

" to

" to enter into it. But all the ſolid parts
" of the body are made up of nerves
" compacted and preſſed together, as ap-
" pears from obſervations made on the
" growth of the chick in the incubated
" egg; and that of the human embryo;
" and is yearly evinced by *Boerhaave* in
" his Prælections on the Inſtitutions of
" Medicine. Therefore, whatever is an
" ingredient in the compoſition of animal
" ſolids, was before a part of the nervous
" fluid. Since therefore theſe, as Che-
" miſts well know, conſiſt of earth, which
" is as it were the *baſis*; of oil and water,
" which ſerve as a kind of glue; and of
" a certain ſalt peculiar to animals, mild
" and neutral, which by diſtillation in a
" retort, is rendered alcaline and volatile,
" intimately blended and united with the
" other principles; it certainly follows,
" that the animal ſpirits contain all theſe,
" and that they are as it were the quint-
" eſſence of the blood and other juices;

" the

" the vehicle of which is lymph or water,
" extremely defæcated and moveable, and
" extremely attenuated by flowing thro'
" veſſels, which from large become gra-
" dually ſmaller, and are at length leſ-
" ſened beyond all imagination; rarefied
" by heat, and approaching nearer to the
" nature of vapour, than that of a ſenſible
" fluid; which water is impregnated with
" the before-mentioned earth, oil and ſalt,
" all extremely attenuated and intimately
" mixed together, and imperceptible to
" all our ſenſes, till, after the nutrition of
" their proper canals being perfected,
" they are fixed into a ſolid and conſi-
" ſtent ſubſtance. From all which it is
" evident, that it is neither neceſſary nor
" free from error, to liken animal ſpirits
" unto the particles of light, urinous or
" fermented ſpirits, or any other liquid
" whatever, differing from that we have
" juſt now deſcribed. NOR DO I THINK

" THAT ANY ONE THING, EVEN IN THE
" ELEMENTS OF GEOMETRY, MORE EVI-
" DENTLY FOLLOWS FROM DATA, THAN
" THIS POSITION FROM THE EXISTENCE
" OF ANIMAL SPIRITS, BEING LAID
" DOWN OR TAKEN FOR GRANTED."

The reader will be pleaſed to obſerve, that in this paſſage Boerhaave *is ſpoke of as then living and continuing his yearly lectures; but he died in the latter end of* September, 1738, *and therefore that this diſcourſe was written before his death. And accordingly it is dated* June *the firſt*, 1738. *But by the accident of the Printer's failing, to whom the copy was delivered, it was not publiſhed till above a year after.*

When I was writing the above tranſlated paſſage, I had no books by me, that could be of any uſe with reſpect to the ſubject I was upon, but Boerhaave's Inſtitutions, Cheyne's *Engliſh* Malady, *and the ſecond edition of* Monro's Oſteology, *to which is*

ſubjoined a deſcription of the nerves: *from which laſt treatiſe, I tranſlated and inſerted in my diſcourſe his account of the celebrated experiment on the* phrenick nerve. *I had read, many years before, moſt of the authors of note, that treated of the nerves and nervous fluid; and was pretty ſure that none of them had ſuggeſted any thing, which at any time had made the leaſt impreſſion on my mind, ſo as to lead me into that opinion, concerning the nature of animal ſpirits, which is there delivered. And this made me the leſs ſollicitous to be at the trouble of procuring them, and reading them over anew on this occaſion. As for the three books I have mentioned, it is evident they contain nothing that hath the leaſt tendency that way.*

After my book was printed off and publiſhed, being wholly taken up with the practice of phyſick and practical ſtudies, I thought no more on this theoretical ſubject, till

till a few months ago, when the celebrated Haller's *Phyſiology firſt fell into my hands. As I was no ſtranger to that author's learning and abilities in every thing relating to the animal œconomy, I forthwith purchaſed it, and upon a careful peruſal, found it in the general, to contain according to my own judgment, by far the fulleſt, as well as the moſt correct account of the functions of the human body, that hath yet appeared; a treaſure rather than a book. But it was with a particular eagerneſs and attention, that I read over and over his paragraphs on the nerves and nervous juice, my old favourite ſubject. In theſe I found him a zealous, as well as able ſtickler for the cavity of the nerves, and the reality of a nervous fluid. And his ſummary of the arguments for the affirmative, appeared ſo pithily drawn up, that I thought I could not diſpenſe with inſerting a literal tranſlation thereof in the treatiſe. Some ſuch ſummary*

was neceſſary in its proper place, and I could do nothing of my own ſo well.

But tho' he appears as fully convinced of the exiſtence of a fluid in the nerves, as the abſtruſeneſs of the thing will permit a wiſe philoſopher to be, yet he is perfectly a ſceptick with reſpect to its nature and conſtituent parts; and after recounting all the different opinions of writers on that ſubject he could think on, declares himſelf diſſatisfied with every one of them.

It is certain that he was appriſed of my book, as it is not omitted in the catalogue of medicinal writers he hath lately publiſhed, in his edition of Boerhaave's Method of ſtudying Phyſick, corrected and enlarged. *It would likewiſe appear by his manner of mentioning it, that he had peruſed it with ſome attention. But the paſſage we are now conſidering, ſeems to have made no impreſſion upon him in its favour. I in-*

cline

cline to believe, he might the leſs regard it, becauſe I there take it for granted, that, according to Boerhaave's *doctrine, all the ſolids in the animal body were originally nerves; an opinion which he himſelf diſputes, and contends that at leaſt ſome part of them are made out of the cellular membrane, without having ever been in a nervous ſtate. But independently on ſuch a ſuppoſition, the ſole nutrition of nerves in the adult animal body, which are to undergo no ſubſequent change, is a ſufficient foundation for my reaſonings.*

However that be, the modeſt diffidence of ſo great a man, and his backwardneſs to draw any definitive concluſion concerning the nature of a nervous fluid, with all his extenſive and accurate knowledge of theſe data, *which were moſt likely to yield a ſatisfactory and ſcientifical one, ſenſibly affected me, who had, many years before, ſo hardily and peremptorily pronounced in print*

print upon the matter; and determined me to review and re-examine what I had then offered to the publick.

And first, I set about enquiring whether any author before the year 1740, *being that in which my book was printed, had broached the same opinion. I might fairly go up as high as* 1738, *my papers having been then delivered to the Printer; and even to* 1735, *as in that year I had printed the first book of the Poem, in which the substance of the doctrine is clearly delivered, and applied to practical purposes, as may appear from some passages thereof, likewise to be found at the end of this preface; copies of which first book printed in* 1735, *were read by many in* Yorkshire, *and particularly by the learned and celebrated gentleman already mentioned, to whom the prose discourse in the form of an epistle was addressed; and some of them may be still produced. With this view, and for this purpose,*

poſe, I conſulted Bohnius, Verheyn, *the lateſt editions of* Boerhaave's Inſtitutions, *and his* Prælections *on them as publiſhed by* Haller *with his own additional notes; but could find nothing at all to that purpoſe in any of them. As theſe authors mention and take under conſideration, all the different opinions of former writers on this ſubject, that are worth notice, I judged it unneceſſary to turn over any more.*

But reading downwards, I had the ſatisfaction and pleaſure to find my ſyſtem adopted and followed by that unexceptionable judge of every thing, whether ſpeculative or practical, that pertains to the medicinal art, Profeſſor Monro, *in his moſt elaborate and inſtructive treatiſe on the nerves in general, added to the third and ſubſequent editions of his Oſteology, and printed in* 1741, *the year after my* Latin *book was publiſhed; a copy of which was tranſmitted to him ſoon after its publication. In that treatiſe of the nerves ſub-*

joined

joined to his ſecond edition, there is not the leaſt veſtige of any thing tending to unfold the conſtituent parts of the nervous fluid, as I have already obſerved; but in this, he not only adopts my doctrine, but illuſtrates and confirms it by a variety of arguments. He mentions not indeed my name, becauſe he ſets out with the reſolution of mentioning no names at all, to avoid animoſities or diſputes. " *I have not, ſays* " *he, named one author, flattering myſelf* " *that thoſe I was under a neceſſity to re-* " *dargue, might be the better concealed, by* " *my not declaring whom I approved of.*" *In the preface to his fourth edition, printed in* 1746, *he expreſſes the ſame thing in other words,* " *I have not only concealed* " *the names of the writers whoſe ſentiments* " *were different from mine, but have ſhun-* " *ned quotations from thoſe I approve of,* " *leſt the knowledge of the latter, ſhould be* " *a key to diſcover the former by.*" *Here, with ſubmiſſion to my much eſteemed maſter, I cannot help thinking the cautiouſneſs that*

reſtrained him from doing juſtice to theſe authors he believed were in the right, for fear of diſobliging thoſe he was ſure were in the wrong, to have been ſomewhat outrée *or too far puſhed; tho' perhaps it is more excuſable in a publick profeſſor, than any other writer. It certainly hath a natural tendency to ſtifle or blunt the keeneſt of all incentives, to labour for the advancement of arts and ſciences, to wit, the deſire of honeſt fame, and of reaping the advantages ariſing therefrom. If ſuch a conduct obtained univerſally, the broachers of any thing new, however ingenious or uſeful, would ſeldom or never ſee their names in print, except in the title pages of their own books; and compilers would have a manifeſt advantage over original authors.*

To place this my ſyſtem, for ſo I have an undoubted right to call it, as, I hope, is evidently made out, in a clear light; to render it more conſpicuous by its appearing ſingle and uneclipſed by more ſhowy com-

panions, the reverſe of which hath been its fate hitherto, is my deſign in the following pages. I have, not out of oſtentation, but for the ſake of method, preciſion, and force or weight, thrown them into the form commonly uſed by geometrical writers. Moreover, I apprehended, that by this way of ranging my thoughts, the reader will be enabled more eaſily to ſpy out any material ſlip or fallacy in the reaſoning, ſhould there be ſuch, than he well could in an uniform diſcourſe, not marked out into diſtinct parts, by the titles of Lemma, Propoſition, *or* Corollary. *And as I perceived, that the celerity of muſcular motion was a principal ground of doubt with* Haller, *and through his authority would queſtionleſs have the ſame effect upon many others, I have taken it into cloſe conſideration, and endeavoured to clear up that grand difficulty.*

If it ſhould be aſked to what uſeful end this abſtruſe enquiry tends, I would readily anſwer, to round as it were, and in ſome

meaſure complete our idea of the animal body, which the parent of medicine, the divine Hippocrates *hath compared to a circle: to explain the nature of the* τὸ Ενορμὸν, *the* impetum faciens, *or the immediate corporeal cauſe of motion, the effects of which we ſee and feel, while itſelf is hid from our ſenſes, and diſcoverable only to the eye of reaſon and ſcience; and, which is the chief advantage of our theory, to ſhew all to be conſiſtent with and analogous to animal nature, as conſidered in itſelf, and as it were within its own eſtate, without going abroad for, and obtruding foreign and unneceſſary beings or properties; but evincing by argument what* Hippocrates *ſmelled out by ſagacity, to wit, that* corpus ipſum ſibi ipſi idem eſt, & ex iiſdem conflatum. *But the utility of our enquiry doth not ſtop here. As the ſame* impetum faciens, *or active fluid, hath a very large ſhare of influence on the diſorders of the animal machine, the clearer, juſter, and fuller ideas we have of its nature and conſtituent parts,*

the more maſterly and comprehenſive will our knowledge be of the various diſeaſes in which it is materially concerned, and of the methods and remedies requiſite for their cure.

PASSAGES *referred to in the* PREFACE.

Diſſertation. epiſtolar. pag. xxx. et ſeq.

ANtequam hanc materiam miſſam faciam, breviter de natura ſpirituum animalium inquirendum. Etenim quotquot autores me legiſſe memini, nec in praeſenti ſunt libri ad manum, minus de ea re ſatisfaciunt. Quin potius miror obviam quandam, et facilem ratiocinationem iis in mentem non veniſſe, quae eſt hujuſmodi: Quum ſpiritus animales ſint liquida omnium in corpore animato ſubtiliſſima, debent nervi ab iis ſolis ali et nutriri; impoſſibile enim eſt canalem aliquem nutriri a liquore craſſiore, quam ut eum ingredi poſſit. At vero omnes in corpore partes ſolidae ex nervis compactis et coagmentatis fabricantur, ut ex obſervationibus captis de pulli in ovo incubato, et humani embryonis incremento patet; et quotannis in praelectionibus ſuis theoreticis confirmat Boerhavius. *Ergo quicquid*

quid ſolidarum partium compoſitionem ingreditur fuit ante in nervorum liquidis. Quum autem eae, ut norunt Chymici, conſtent terra, quae veluti baſis eſt ; oleo, et aqua, quae glutinis loco inſervit ; et ſale quodam animalibus proprio, blando, neutro, quodque diſtillatione per retortam alcalinum, et volatile redditur, cum reliquis principiis intime miſto et unito ; utique ſequitur ſpiritus animales omnia haec principia continere : ac proinde eſſe velut quintam, ut loquuntur, eſſentiam ſanguinis et ſuccorum relinquorum : cujus vehiculum eſt aqua, vel lympha puriſſima, mobiliſſima, fluxu per vaſa, quae gradatim ex capacioribus auguſtiſſima, et ultra omnem imaginationem ſubtilia deveniunt, admodum attenuata ; calore rarefacta ; et vaporis potius, quam fluidi ſenſibilis naturam referente ; quae ſimul imbuitur terra, oleo, et ſale praedictis ; itidem tenuiſſimis, maximeque elaboratis, et ſubactis, intimeque permiſtis ; quaeque omnes ſenſus fugiunt, antequam proprio-rum canalium nutritione peracta, in ſubſtantiam ſolidam et conſiſtentem tandem converſa ſint. Unde quidem patet nec eſſe neceſſarium, nec erroris expers, ſpiritus hoſce comparare cum particulis luminis, cum ſpiritibus urinoſis, fermentatiſve, vel cum alio quovis liquore ab eo diſcrepante, quem modo deſcripſimus. Nec puto quidquam, vel in elementis geometricis evidentius ex datis ſequi, quam placitum hocce ex poſita ſpirituum animalium exiſtentia.

Neuropath. lib. 1. verſ. 241. et ſeq.

Praeterea longo ſi duret tempore labes,
Debilitabitur ulterius, languenſque fatiſcet
Daedala nervorum, et teneri ſtructura cerebri:
Nimirum quoniam a crudo, vapidoque liquore
Nutritum debent omnem trahere, atque alimenta.
Omni etenim momento animali in corpore vivo
Extenduntur, et elongantur tenuia vaſa,
Vi propulſorum jugi diſtracta liquorum:
Diductis hinc a ſe partibus attenuantur:
Fineſque avulſi franguntur, et abraduntur;
In cute ſquamarum forma ſpecieque cadentes,
Aeris attactu deſiccati, atque coacti:
Interne vero liquidis mixti abripiuntur.
Aſt interſtitia, et defectus inde relictos
Non alius ſupplere liquor, ſarcireve poſſit,
Quam qui eadem penetrans pertranſit et alluit uſque.
Nervi igitur tenues nimirum, et molle cerebrum
Nutritum a propriis liquidis quaerunt, capiuntque;
His etenim mage nequaquam ſubtilia dantur,
Aſt eadem vero male cocta, et inertia ſi ſint,
Debiliter compingantur, laxeque neceſſe eſt,
Queis nervi conſtant ſtructi, cerebrumque elementa:
Proptereaque ipſis robur virtuſque fatiſcat.

Ibid.

Ibid. verſ. 276. et ſeq.

Scilicet ille liquor, qui ſanis continet in ſe
Attenuata, probeque ſimul permiſta elementa,
Nempe ſalem, blandumque oleum, terraeque minuta
Corpora, ſubtili lymphae fluitantia rore;
Vi vitae valide conquaſſata atque ſubacta;
Degener hoc morbo factus, vapiduſque aqueuſque;
Paucaque complectens elementa animalia pauper;
Mobilitate celer nimia, nimiumque ſolutus
Diffluit, et nervis ſubito nimis evolat ipſis.
Et cerebri, nervûmque, valentibus et bene ſanis
Quae contenta gradu quodam, atque elaſtica conſtant
Stamina, pro ſexu variaque aetate animalis;
Compactiſque vigent inter ſe firma elementis;
Debilitata mala labe, et compagine fracta,
Intempeſtiva molleſcunt flacciditate:
Dum crudus, tenuiſque humor nimis alluit omnes
Anfractus, tortuſque vagos, cellaſque cerebri.
Nervorumque tubos, et flumine macerat udo.
Quin et debiliter conjectis ipſe elementis,
Ut docui ſupra, teneras male nutrit, alitque
Nervorum et cerebri fibras, et daedala vaſa;
Virtutem roburque evertens corpore toto.

The two following Books,

Sold by A. MILLAR in the *Strand.*

NEUROPATHIA;

SIVE DE

Morbis Hypochondriacis et Hyſtericis,

LIBRI TRES,

POEMA MEDICUM.

Cui praemittitur

Diſſertatio Epiſtolaris proſaica ejuſdem Argumenti.

A

Propoſal for the Improvement

OF THE

Practice of MEDICINE;

Illuſtrated by an Example relating to the

SMALL-POX.

To which is added,

A DISCOURSE on *Medicinal Indications, Specificks,* and *Panaceas,*

Wherein are introduced ſome Remarks on a Book, entitled *Siris*; and the Properties of *Tar-Water.*

Both by *Malcolm Flemyng*, M.D.

THE

Nature of the nervous fluid or animal ſpirits demonſtrated.

ASSUMPTION.

Nerves are hollow canals or tubes, the ſmalleſt of all in the animal body, which contain and tranſmit a peculiar juice or fluid.

MY intention in this paper, is not to demonſtrate the exiſtence of a nervous fluid, but to inveſtigate and find out the nature of ſuch a fluid, ſuppoſing it actually to exiſt. I pretend to add nothing material to the cloud of arguments, which great men have already uſed

in order to eſtabliſh that poſition, and which I, for my own part, believe to be unanſwerable. But that the reader may judge for himſelf, I ſhall lay before him the words of the very learned *Haller*, in which their ſubſtance is briefly as well as pithily ſet forth. The poſition itſelf being too far removed from ſelf-evidence to be termed *Axiom*, nor with propriety to be ſtiled *Poſtulatum*, as it requires nothing to be done or executed; and being ſupported with too many weighty arguments to be diſhonoured with the name of *Hypotheſis* or ſuppoſition, nor to be called Propoſition in the geometrical ſenſe of the word, becauſe a formal demonſtration is not ſubjoined; I have, upon theſe accounts, choſe the appellation of Aſſumption. The reader may, if he pleaſes, term it *Datum*, or a thing given, or taken for granted. But I proceed to quote *Haller*,

Parag.

Parag. CCCLXXXVI. " The controverſy
" begins concerning the nature of that
" fibre, which with others like itſelf, con-
" ſtitutes both the *Medulla* and nerves.
" Many of the moderns have aſſumed
" that it is ſolid, ſo as only to be moiſt-
" ened by a vapour exhaling into the
" cellular texture enveloping the nervous
" fibres.

Parag. CCCLXXXVII. " The ſtrong rea-
" ſons which we ſhall adduce, do not
" permit us to embrace this opinion.
" The cortical part of the brain is vaſ-
" cular every where, and is continued to,
" and coheres with the medullary part
" by an uninterrupted inextricable con-
" nexion, in ſo manifeſt a manner, that
" there is no room for the leaſt cavil to
" make the thing doubtful. Then, a very
" great quantity of blood comes to the *Cor-*
" *tex* of the brain; ſee Numb. CCCXXXIX.

" and laſtly, the *Medulla* and *Cortex* con-
" ſtantly grow in all dimenſions in the
" ſame proportion. From all which duly
" weighed, I conclude that the ſmall veſ-
" ſels of the *Cortex*, of which it is ſolely
" compoſed, N. CCCLIX. are continued to
" the fibres of the *Medulla*, of which that
" is likewiſe wholly made up; and there-
" fore, that they are not ſolid, ſince, if
" that were admitted, a very copious fluid
" arriving at the *Cortex* through the *ca-*
" *rotid* and *vertebral* arteries, muſt return
" uſeleſs, becauſe beaten back by the ſolid
" *Medulla*. And beſides, the proportional
" increaſe of the *Cortex* with that of the
" *Medulla*, manifeſtly points out one com-
" mon cauſe of both their growths. And
" that is by N. CCXLIX. the ſuperior force
" of the heart, which extends and length-
" ens the blood-veſſels. It remains then
" to conclude, that the *Medulla* is likewiſe
" made up of veſſels, which may be di-
" ſtended by the ſame force of the heart.

CCCLXXXVIII.

CCCLXXXVIII. " The phænomena of " wounded nerves do not ſuffer us to " believe them to be ſolid. For, if a " nerve ſhakes when irritated, in the man- " ner of an elaſtic chord, which trembles " when ſtruck, it ſhould be compoſed of " hard fibres, whoſe extremities ſhould be " faſtened to firm bodies, and bent; for " ſtrings that are either ſoft, or unbent, " or not made faſt, cannot ſound. But " all nerves are medullary in their origin, " and very ſoft, and very far from being " tended. For ſome of them all over their " lengths are ſoft in every part; for in- " ſtance, the olfactory nerve, and the ſoft " portion of the auditory nerve, from " which latter we might moſt expect vi- " bration, as it is the inſtrument of hear- " ing, which is excited by ſound. Then " tho' nerves are ſomewhere hard, yet " they grow ſoft in the *Viſcera*, in the " muſcles, and the ſenſories, before they

" exert

" exert their functions. Therefore ner-
" vous fibres, as they are neither ſtretch-
" ed in their beginning, nor termination,
" cannot vibrate through elaſticity. But
" moreover, in peculiar and very remark-
" able inſtances, it is impoſſible they ſhould
" tremble, becauſe they are, for a great
" part of their paſſage, tied down firmly
" to hard parts by the cellular texture;
" for example, the nerves of the heart are
" faſtened to the great arteries and *Peri-*
" *cardium.* And laſt of all, the following
" experiment demonſtrates the nerves to
" be entirely void of elaſticity; to wit, a
" nerve cut aſunder neither becomes ſhort-
" er, nor draws back its divided extre-
" mities towards the firm parts, to which
" it is faſtened, but becomes ſomewhat
" longer through laxity, and thruſts out
" its *Medulla* into a round tubercle.

CCCLXXXIX. " Add to all this, that the
" influence of an irritated nerve is never

" pro-

" propagated upwards, muſcles above the
" place of irritation never being convulſed,
" however much firmer the trunk of the
" nerve there be. This is entirely foreign
" to the nature of elaſticity, for a chord
" ſtruck, propagates its tremors equally to
" both ends from the place of percuſſion.
" This ſhews that there is a fluid, which
" comes from the brain, and flows down
" through the nerves to the extreme parts,
" the motion of which fluid being acce-
" lerated by irritation, acts ſolely in the
" direction of its current, and cannot pro-
" duce convulſions upwards, as new fluids,
" iſſued from the brain, prevent that effect.
" Nor is that experiment in the *phrenick*
" nerve to be diſregarded here, by which
" it appears, that it being compreſſed, but
" at the ſame time rubbed downwards,
" aſſiſts the motion of the diaphragm, and
" when rubbed upwards, ſtops its motion
" altogether: From which it is almoſt
" evident, that by the former direction of
" force,

" force, the progreſs of the nervous fluid " is urged on, and by the latter it is coun- " teracted; and that the nerve acts not " after the manner of a chord, which " could never tremble upon being com- " preſſed, in whatever direction the com- " preſſing finger acted.

cccxc. " I therefore think it almoſt " abſolutely certain, that the nervous fibres " are hollow, and that they exerciſe their " functions not by their ſpring, but by " the motion of their proper fluids. Nor " is the extreme ſmalneſs of theſe canals, " which no microſcope can reach, an ob- " jection of any weight againſt the expe- " riments above-mentioned; nor the ab- " ſence of tumor in a nerve upon being " tied, which is not altogether true; nor " other arguments of the like nature, " which only prove the imperfection of " our ſenſes, but avail nothing againſt the

" actual

" actual preſence of nervous ſpirits." Thus much from *Haller* *.

To this excellent ſummary let me ſubjoin ſome brief Reflexions. Here is a proof drawn from the moſt accurate and minute examination of the parts concerned, and helped out by an experiment, which is directly in point, to evince the exiſtence of a nervous fluid, that ſeems to be as valid and convincing, as the nature of the thing can well admit of, where the Teſtimony of our ſenſes cannot reaſonably be expected. And it is, I think, much more to be wondered at, that, in ſo abſtruſe an enquiry, human penetration ſhould have been able to proceed ſo far, than that it hath made no farther advances. At the ſame time, there are arguments produced which abſolutely and beyond all manner of doubt, demonſtrate that the action of the

* Primæ lineæ Phyſiologiæ, 1747.

the nerves cannot poſſibly conſiſt in tremulous vibration cauſed by elaſticity. To acquieſce in an opinion ſo ill founded and ſo eaſily overthrown, argues either a groſs ignorance of the animal ſtructure, or, which is more culpable, a ſupine or wilful inattention to it. Beſides that, if ſuch vibrations were admitted, however commodiouſly they might explain ſenſation, they could nowiſe account for muſcular motion; for what hath trembling to do with traction or pulling? ſo that they, who maintain the oppoſite ſide of the queſtion, before they can make a tolerable figure in their own defence, have a double hard taſk to get over; to wit, firſt, to ſhew the unconcluſiveneſs of theſe arguments, which tend directly, and as it were *a priori*, to prove the nerves to be hollow canals; and when that is done, if it could be done, to point out a feaſible way, in which ſenſation and muſcular motion can be carried on, without either a nervous fluid, or

elaſtic

elaſtic tremor: The firſt being what they themſelves deny, and the latter proved altogether untenible. To hit upon ſuch a medium, I humbly apprehend they will find it far from being eaſy.

If the reader deſires to ſee theſe Matters treated of more at large, let him conſult *Haller*'s edition of *Boerhaave*'s Prælections, with his own Notes; and Mr. *Monro*'s elaborate and inſtructive diſcourſe on the nerves in general.

As the nerves are admitted to be hollow canals, it muſt be granted, that they are the ſmalleſt of all in the animal body, for this very reaſon that their cavities are diſputed.

LEMMA I.

The animal ſolids conſiſt of phlegm or water, of oil, of a peculiar mild neutral eſſential ſalt, which

by putrefaction and diſtillation, becomes alcalious and volatile, and of earth, in the chymical ſenſe of the word; to which laſt is owing their firmneſs and ſtability. Of theſe principles, intimately blended together and incorporated, all the ſolid parts of the animal body are made up and compounded.

This is ſo univerſally acknowledged by all, that are in any tolerable degree acquainted with the animal œconomy and the rudiments of chymiſtry, that I might ſpare myſelf the trouble of a formal proof. I ſhall therefore be the leſs prolix upon this head.

That phlegm or water makes a part of the animal ſolids, is plain to ocular demon-

demonſtration, as even horns and hoofs, where one would leaſt expect to find it, by diſtillation in a retort yield it in conſiderable quantity. It muſt therefore be found in a much greater proportion in moiſter parts.

That oil is another never wanting ingredient, is evident from the ſame operation, by which a fetid empyreumatic oil is obtained from every ſolid part of the animal fabrick, without exception, unleſs they are previouſly calcined, or robbed of whatever can be extracted from them by boiling water.

That there is likewiſe a certain ſalt in the compoſition of animal ſolids, or at leaſt the conſtituent parts of ſalt, is evinc'd by the ſame chymical *Analyſis*, they yielding a volatile alcaline ſalt by diſtillation. That this ſalt before putrefaction and diſtillation is neutral, that is, neither acid

nor

nor alcalious, appears from this, to wit, that no humor of the animal body in a natural ſtate, no decoction or gelly, extracted by boiling water from ſolid parts, diſcover any ſigns either of the one or the other quality. Even urine, when retained many days in the bladder through diſeaſe, is not then become quite alcalious.

That earth is a principal ingredient in the compoſition of animal ſolids, (which is likewiſe true of vegetables) appears from there remaining after incineration or calcination an inſipid inodorus powder, neither diſſolvable in water, nor fuſible by fire, which is by chymiſts ſo termed. This earth is the firm *baſis* of the other parts, and conſtitutes the compoſition a ſolid; without it the animal fabrick could not be organical. The other parts are but the *Gluten* or bond of union, by which the whole coheres, and acquires a certain degree of hardneſs and rigidity,

according

according to the greater or leſſer proportion of the earth to the *Gluten*. This is illuſtrated by the following plain inſtances: A hair in its natural ſtate is tough; burn it, it retains its fibrous form, but the coheſion of its parts is loſt, and you may blow them aſunder; the fire hath diſſipated the water, and conſumed the oil that glued them together. Bones in their own nature are hard and rigid, calcine them thoroughly, tho' they retain their ſhape and figure, they will become friable, and may be crumbled to powder between the fingers. Dip the ſame bone in oil, or even in water, and its tenacity will be recovered in a remarkable degree. The proceſs of making earthen and porcellane ware, furniſhes another confirmation of the ſame doctrine.

COROLLARY.

The above propoſition being ſo well evinced by the moſt diligent and accurate

enquiries

enquirers into nature, that I believe none; but ſuch as are diſpoſed to cavil, will call it in queſtion; it may be fairly reaſoned from as a principle. But before I proceed to another, that I may take away, as much as is poſſible, all occaſions of either miſtake or altercation, let me obſerve that as the nerves are ſolid parts, that is, not fluid, they muſt be acknowledged to contain the ſame principles with the other ſolid parts of the animal ſtructure, tho' they cannot be examined and analyſed a-part; that is, ſeparated from every other thing, which doth not properly conſtitute a nerve, taken in its ſtricteſt ſenſe; as the membranes that invelope them, the cellular texture in their interſtices, minute veſſels, &c. To deny this, becauſe it cannot be plainly ſhewn and made manifeſt to the ſenſes, would be mere chicanery. If they are fibres, whether hollow or impervious, they muſt, according to the laws of fair analogy, have terreous elements for the baſis and ſtay of

the other principles that conſtitute them, to preſerve their figure, continuity and direction, and render their functions permanent, whatever theſe be.

LEMMA II.

The matter of the nutrition of the ſmalleſt veſſels in the animal body, is ſupplied, at leaſt, in a conſiderable meaſure, if not principally, by the fluids or juices, which pervade their cavities.

Fluids, however mild, conſtantly flowing with whatever velocity through ſoft canals, muſt create a perpetual abraſion in their inſides, which would of courſe wear out and deſtroy them, unleſs there was a conſtant ſupply of matter to compenſate that loſs: This is what is called nutrition.

In the ſmalleſt Veſſels of all, as their walls or coats cannot be compoſed of other veſſels, for then they would not be the ſmalleſt; but every diſtinct veſſel muſt be one ſolid tube, the waſte by abraſion can be made up only by one or both of the following ways; either the liquor flowing through them leaves behind it as it goes on, matter ſufficient to replace what hath been abraded; or their places muſt be filled up by particles from without, penetrating through the whole thickneſs of the canals, and ſettling in the ſame holes or vacuities, from which the *Ramenta* were torn and carried off with the permeating fluid. By one or other, or both of theſe ways, and by theſe only, can the veſſel be preſerved ſound, and of the ſame figure and dimenſions, for any conſiderable time.

Let us apply this doctrine more particularly to the nerves, which, according to the Aſſumption, are the ſmalleſt veſſels in the animal

animal body. As they are diſtinct filaments, ſheathed over with thick-woven tenacious membranes, and tied cloſely together in bundles, parallel to one another, except where they are diveſted of theſe membranes, and ſpread like *Mucus*, as the *Retina* is for example; the only way they can receive their nouriſhment from without, is by a vaporous moiſture, penetrating both through their membranes, and the whole thickneſs of their coats, and leaving nutritive particles fixt in the gaps and breaches, from which the abraded ones were torn and ſwept off. And this ſupply muſt conſtantly keep pace with the abraſion itſelf, if the nerves are nouriſhed no other way.

That this is neither the only, nor the principal way of the nutrition of nerves, will, I hope, appear from the following conſiderations.

Firſt, It is repugnant for it to be ſo, to the general manner of nutrition in the other veſſels of the animal body, as acknowledged by modern authors, who have gone fartheſt into the conſideration of theſe matters. They allow a nutritive or plaſtic quality in the fluids, which immediately repairs the breaches made by abraſion as they go on, tho' they have not taken the nutrition of nerves into conſideration.

Secondly, It is not agreeable to the ſimple and direct procedure of nature, to have the whole or greateſt part of the matter of nutrition brought from without, when the whole or greateſt part of the waſte or *Diſpendium* is made within.

Thirdly, The ſupply from without by a vaporous moiſture, or any other contrivance whatever, that can well take place in the animal body, is too uniform to keep equal pace with the abraſion made by the nervous fluid,

fluid, which upon different occaſions is very different in the ſame nerves; and always different in different nerves, according to the nature of the functions they influence. Let us for inſtance ſuppoſe, a ſeamſtreſs working twelve or fourteen hours in the twenty-four. There is in that caſe, a quick long continued motion of the nervous fluid in theſe muſcles, which move the fingers and arm; and yet the ſupply of a moiſt vapour can be little or nothing more, than if theſe muſcles were at reſt, as the heat of the body is little or nothing raiſed by that kind of work. The heart in a perſon in health beats 5000 times in one hour; but its nerves can be no more liberally furniſhed with a nutritive vapour from without, than other nerves in the circumjacent parts, which preſide over much ſlower functions.

Fourthly, It is inconſiſtent with the extreme ſubtlety and tenuity, if I may uſe the

the word, of the nervous fluid, to maintain that the canals, through which it flows, are repaired ſolely or principally by the appoſition of particles from without, penetrating through the whole thickneſs of their coats or walls. As the nervous fluid has impulſe and motion on its ſide, while the nutrient moiſture is comparatively at reſt, ſuppoſing the ultimate particles of both to be equally attenuated, the nervous fluid will more readily penetrate through the ſides of its own canals, than the nouriſhing moiſture, either in the way of nutrition or evaporation. It is hardly to be ſuppoſed, that they are leſs divided and comminuted, than the nutritive particles in the vapour; now that they are arrived at the cavities of the ſmalleſt veſſels, and therefore have undergone the whole proceſs of the operations of the animal fabrick and œconomy.

Laſtly,

Laſtly, The uniform and proportional growth of the whole brain, the medullary, and the nervous ſyſtem, as it affords an invincible argument to prove their texture to be vaſcular, ſo it carries ſcarce leſs weight with it to incline us to believe that the chief matter of their accretion, and conſequently that of their nutrition, is conveyed through the channels of their minuteſt canals, and therefore is applied principally to their inſides; ſo complex and intricate an organiſed texture, can hardly be conceived to be increaſed gradually and uniformly, in ſuch an infinite number of diſtinct mæanders and receſſes, by means of a nutritive moiſture ſoaking indiſcriminately through the whole maſs.

From all which I conclude, that the chief matter of the nutrition of the nervous tubes, is furniſhed by the fluids which they tranſmit, and applied within their cavities;

cavities; and that the vaporous moiſture, we have had ſo oft occaſion to mention, is principally employed to keep the membranes in repair, as their ſtructure is leſs organiſed, and they lie moſt opportunely to receive its benefit.

PROPOSITION.

The nervous fluid or animal ſpirits, conſiſts of phlegm or water, oil, animal ſalt, and earth, all highly attenuated and ſubtiliſed, and intimately mixed and incorporated together.

All animal ſolids contain theſe principles, and the nerves amongſt the reſt by *Lemma* firſt, and the Corollary drawn from it: The nerves are nouriſhed principally by the nervous fluid according to *Lemma* ſecond: But that fluid cannot give to the

nerves

nerves what it contains not itſelf; therefore the nervous fluid muſt contain ſome proportion of all theſe principles. The nerves are the ſmalleſt of all the veſſels in the animal body, according to the *Aſſumption*; therefore the fluid they tranſmit muſt be made up of parts highly attenuated and ſubtilized, and intimately mixed and incorporated together, in order to be fit for being moved through ſo minute canals, freely and without obſtacle. Which is what was intended to be proved.

SCHOLIUM.

It will no doubt appear ſtrange, that an enquiry ſeemingly ſo abſtruſe, ſhould terminate in ſo great ſimplicity. But that is the caſe with many truths of the greateſt importance. It will likewiſe be natural here to aſk, how it is poſſible that muſcular motion can be cauſed by ſuch a fluid, with all the circumſtances of force

and celerity, eſpecially the latter, that it is attended with? and other queſtions of the like kind. To which I have a right to anſwer, that, from the nature of the ſubject I have undertaken to treat of, I am not obliged to ſay any more than what is already ſaid upon theſe matters, unleſs my reaſonings are found fault with; in which caſe, I ſhould think myſelf under an obligation, as well in point of deference to the publick, as juſtice to myſelf, to defend them if I could, or give up the cauſe. If I am in the right, there is ſome addition made to the general ſtock of natural knowledge; and I may leave it to others to proceed farther, as their abilities and opportunities may permit. This, I ſay, I have a right to anſwer. But I ſhall take this opportunity to add ſome reflexions, which at preſent occur to me, that have a pretty cloſe connection with our ſubject.

In the firſt place, I pretend not to prove that there is nothing elſe in the nervous fluid, beſides the principles I have enumerated. But theſe principles, I affirm, it muſt conſiſt of, if the nerves are canals, and contain a fluid. There may be in animal fluids in general, and that of the nerves in particular, ſome ſubtle æther, fire or ſpirit, or whatever other name it may be called by, diffuſed through the atmoſphere, and perhaps over our whole ſyſtem, acting by laws unknown to us, and in a particular manner in organiſed bodies; I ſay, there may be ſuch a ſpirit neceſſary to cauſe muſcular motion in co-operation with the proper fluid of the nerves, which is the product of the animal fabrick and œconomy, and yet all my reaſonings ſtand good. Be that as it will, certain it is that the nervous fluid I have deſcribed, if there is really a nervous fluid, is at leaſt a *conditio ſine qua non* of

ſenſation and muſcular motion. A nerve compreſſed between the fingers, or tied round with a thread, immediately ceaſes to act; as ſoon as the compreſſion or ligature is taken off, ſenſe or motion returns; which evidently ſhews, that no æther or univerſal ſpirit is ſufficient to excite the functions depending upon a nerve, though the nerve is entire, without the preſence and co-operation of its proper liquid. To ſhow that a fluid in the nerves is the immediate cauſe of muſcular motion and ſenſation, and to explain and unfold the nature of that fluid, conſidered as an animal production or juice, is enough for the phyſician, without aſcending higher into general and remote cauſes.

The ready, and as it were inſtantaneous production of muſcular motion upon the determination of our wills, and the amazing celerity thereof in a thouſand obvious inſtances, as in a muſician, for example,

playing

playing upon an organ or violin, or a drummer rolling, hath induced ingenious and ſpeculative men to look about, and ſearch for ſuch cauſes as might be adequate to that wonderful effect. I ſhall therefore take this point into conſideration here, repeating ſome things, which I have touched upon in a *Latin* diſcourſe, publiſhed eleven years ago *.

Time is infinitely diviſible, as well as matter or extenſion. A muſket-bullet deſcribes a certain line in a ſecond, ſuppoſe an hundred yards, which is but a very moderate length to aſſign it: An hundred yards contain 3600 inches. It therefore deſcribes an inch, taking its velocity from firſt to laſt at a medium, in the 3600th part of a ſecond; the tenth part of an inch, in the tenth of that time, and ſo on. Now every preceding part, however minute, of this line of an hundred yards, muſt be got over

* Neuropathia, printed 1740.

over before the bullet can arrive at the next. Hence we ſee that the diviſibility of time keeps pace with that of a line, which mathematicians have demonſtrated to be infinite, and which this ſingle example is ſufficient to convince us of.

Time is meaſured by motion, and motion in its turn is meaſured by time. That portion of time in which a body deſcribes a line of two inches, is double that in which it deſcribes but one with the ſame velocity; and that velocity with which a body deſcribes a line of two inches, is double that with which it runs over but one, the times being equal.

Length and ſhortneſs of time, and ſlowneſs and celerity of motion, are only relative or comparative terms; there being no abſolute univerſal ſtandard above or below which, any definite portion of time can be

called

called long or ſhort, or any definite progreſs of motion, ſlow or quick.

In like manner, no part of matter or extenſion is abſolutely great or ſmall, but relatively, as different portions thereof are compared together.

Our ſenſes are limited within a narrow compaſs, being ſolely, but perfectly adapted to that ſtate, in which infinite wiſdom hath placed us, and to the parts we are intended to act there. Our imagination keeps pace with our ſenſes, as it is only the copy or picture of our ſenſations. Thus we cannot truly form in our minds, the image of either a larger or a leſs ſpace, than our ſight can take in or perceive. We can indeed think of ſuch a ſpace, and talk and reaſon about it; but that is intellect, not imagination. And we can frame no image of a part of time, ſmaller than our perception of the progreſſion of motion

tion will permit. The more diſtinctly we can perceive the progreſs of the body moved thro' the ſucceſſive ſmall parts of the line it deſcribes, the ſlower its motion appears; the nearer we are loſing that perception, the motion appears ſo much the ſwifter; and when we actually loſe it, the tranſlation of the body ſeems not progreſſive but inſtantaneous. This will be very much illuſtrated by the following familiar example.

There is nothing more certain, than that the production and diffuſion of ſound is not inſtantaneous, but requires a determined time to be propagated in, anſwerable to the diſtance to which it is extended. By undoubted experiment, it is found to move ſomething more than one thouſand feet in one ſecond. But even in a large room we are not ſenſible of this progreſſion, and can perceive no interval of time between the motion of a ſpeaker's lips, and

our hearing his words. The reaſon is plain, ſound moves above fifty feet in the twentieth part of a ſecond, which is a diviſion of time much too minute for our ſenſes to diſtinguiſh, or imagination to repreſent.

A ſimilar manner of reaſoning will, I think, be of no ſmall uſe to clear up the grand difficulty in muſcular motion, to wit, that concerning its quickneſs and celerity. If the interval between the exertion of our will, and the execution thereof, by the influx of nervous juice or animal ſpirits, into the muſcle or muſcles of voluntary motion, intended to be employed, be ſo ſmall a part of time, as not to be meaſurable by our ſenſes and imagination, then ſhall the effect of our will appear to be inſtantaneous. But methinks this is not ſo extremely wonderful, that it ſhould prove a ſtumbling-block to ſo many great men in this enquiry; eſpecially if we add

to what hath been already ſaid, the following conſiderations, firſt, that ſince the nerves are always full of their proper fluid, it is not neceſſary that that portion thereof, which actuates the muſcles employed, ſhould travel all the way from the *ſenſorium commune* or origin of the nerves, to the muſcles themſelves; becauſe the parts *à tergo*, impel and puſh on theſe that go before; ſecondly, as in a ſtate of reſt the antagoniſt muſcles are equally ballanced with one another, a very ſmall additional quantity of fluid will be able to conquer the *Æquilibrium*.

From all which it appears plain to me, that, tho' our nerves were much longer than they are, the contraction of muſcles employed in voluntary motion, may, and even muſt ſucceed upon the exertion of our will, in a much ſhorter interval of time, than can be the object of our perception, and therefore ſeem to us inſtantaneous.

taneous. And from this ſingle poſition the greateſt celerity of motion or action ever obſerved in the human body, may be eaſily deduced; ſo great is the ſimplicity of truth!

We ſhall for clearneſs ſake, give one example of the manner of making the deduction, which, with a proper allowance for diverſity of circumſtances, may ſerve for explaining any other ſpecies of voluntary motion how ſwift ſoever. There are few ſuch motions in the human body carried on with greater agility, than that manner of beating the drum, term'd rolling; this is performed by the alternate action of the flexors and extenſors of the *Cubitus* or fore-arm, and the wriſt: The moſt dextrous drummer cannot ſtrike the drum with one ſtick, above five times in one ſecond, and, I believe, even that is more than can be executed: At every ſtroke the ſtick is both lifted up and im-

pelled downwards; and therefore, let us reckon ten vibrations in the ſpace of one ſecond. Let us ſuppoſe the hand that holds the ſtick, to move four inches every vibration, which is by much too great an allowance, conſidering, that the quicker this alternate motion is, the hand deſcribes the ſhorter arches. Now, in the ſame time that the hand deſcribes an arch of four inches, the ſound produced by one ſtroke on the drum, moves above 100 feet, or 1200 inches; ſo that the motion of the hand is more than 300 times ſlower than that of ſound. But the muſcles which influence this motion of the hand, move much ſlower themſelves, as they are inſerted near the center of motion. And upon this account, a conſiderable abatement in eſtimating the velocity of the nervous fluid is to be made.

The rapidity of the ſucceſſion of action in one muſcle or ſet of muſcles, after that

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of another, needs not create much difficulty, if we attend to what hath been ſaid. As the will can quickly and in appearance inſtantaneouſly actuate ſome muſcles at firſt, ſo it can the next phyſical moment actuate their antagoniſts, at the ſame time dropping or ceaſing to influence the former motion; which, it may again as quickly produce, and ſo on. The one being ſtopped, the other is equally at freedom to take place, as if none had immediately preceded; and therefore, there is nothing to hinder a rapid alternation, any more than a ſingle quick motion.

Why the quickeſt muſcular voluntary motion in the human body, which is at leaſt an hundred times ſlower than the motion of ſound, may not be produced by the influx of a fluid, ſuch as I have deſcribed, into the organiſm of a muſcle, I do not ſee. This difficulty ſeems to be one of that kind of bugbears, which proves

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ſuch only, becauſe it is not cloſely look'd into. If it were practicable to magnify time to the ſenſe, as microſcopes magnify extenſion, we would as readily admit, that the greateſt celerity obſerved in animal motion, might be brought about by a fluid conſiſting of animal principles, as we acquieſce in the belief of the extreme exility of animal tubes, which glaſſes demonſtrate. The latter ſurpaſſes our natural imagination and perception, at leaſt, as far as the former.

But after all, what can the moſt ſubtle fluid in the animal body conſiſt of, but the ſame principles which conſtitute the blood, out of which it is made, ſufficiently attenuated and ſubtiliſed by the organical operations of the live machine? Is not the chick formed entirely out of the white of the incubated egg? Its fleſh, bones, beak, *&c.* and its ſpirits into the bargain? And does not the white of the egg conſiſt of the

the principles we have ſo often mentioned, to wit, water, oil, ſalt and earth? And are not theſe principles unchangeable in their natures by any degree of heat, or any ſolvent within the body? Water muſt be admitted as the vehicle. And is it to be ſuppoſed, that any ſtrainers can purify the animal lymph perfectly, and free it from all mixture of ſalt and oil? And what is to hinder highly ſubtiliſed earth to be incorporated and paſs with the reſt? Why is the attenuation and mobility of ſuch a fluid to be limited, any more than the exility of the canals in which it flows?

As to that ultimate difficulty, concerning the manner of the operation of our will upon the fluids and ſolids of our body, it is common to, and equal in all poſſible explications of animal ſenſation and motion. And as it may, I think, be rightly referred to the poſitive laws of union, between our

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corporeal and incorporeal parts, that is, between mind and body, eſtabliſhed by our all wiſe and all powerful creator, it only affects theſe minute philoſophers called materialiſts.

F I N I S.