R. North
Works Vol. XVIII
Natural Philosophy
BM Add MS 32545[1]

… the Naturalist takes thing's as they are,
and hath to doe with Nothing but their changes …

UPDATED/REVIEWED NOVEMBER 2014

[1] Bound volume; external measurement, 220x255mm; ff. 1-6, 140x187-90mm; ff. 7-30, 160x208mm; ff. 31-60, 150x185mm; ff. 61-79, 120x190mm; ff. 80-91, 160x202mm; ff. 92-346, 163-5x205-10mm. Each of these sections is composed of paper of similar absorbency and opacity. See also further comments on appearance and condition throughout the footnotes, below.

[colophon i]
(inner of board cover)
<in pencil
388a
~~566a~~>

[colophon ii]
(binders' paper)
<stamped: 32,545>

[colophon iii]
(binder's paper)
<page blank>

1r

Notes of my Father[2]

<pencil: handwriting of
Roger North>

[2] This does indeed at first glance appear to be in RN's own hand, which imply's that it was the front sheet of a bundle left to his children. However Jamie C. Kassler (*Seeking Truth. Roger North's Notes on Newton and Correspondence with Samuel Clarke c. 1704-1713*, Ashgate Publishing Limited, Farnham, 2014, p. 24) states much more convincingly that it is in the hand of Montagu; this makes much better sense of what is written.

1v

<red BM stamp>

2r

Thus farr I thinck wee are Sure of [thee?],[3] for
few see a book without being kind Readers
of the title page, & a line or two of yᵉ pʳ=
face. but how long wee shall /so fairely\ jogg on to=
gether, or when part, is past my Skill to
to devine. I know If any thing hold thee
It is curiosity, and telling of tales, there=
fore take Notice I am about to give Some
accº of My Self, & my wares here.

My very good parents Made me learn la=
tine at a free school in yᵉ Country, Where I also
buisied my Self, with squibbs, crackers, Starr=
Kites, Melting Mettalls, turning Joynery, &
Such like Exercises, as yᵉ Severity of our order's
afforded time, & yᵉ place opportunity. After
being Returned home, I conceived a designe
of making an organ out of my own Inven=
tion, a senceless, but daring project, wᶜʰ with
other like designes, were Interrupted by an
Importune Reverend freind, who would needs
Read Seatons logick[4] to Me, but a dispatch
to yᵉ university put an End to all My delights.

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[3] Where I am not sure of my reading of a word I have used square brackets and a question mark as here. Where I have found the text illegible I use [..?] and where the illegibility is the result of a crossing out [~~...~~?]. So as not to fill the text with '*sic*'s I have also used [?] to indicate a form, or spelling, that puzzled me (even where I could read it, and thought it might have been a slip of RN's pen). Note that RN's own page numbering is inconsistent - he misses numbers and repeats numbers. (Of course, any apparent error that you notice might also be be a real one, of my transcription.)

[4] Jamie C. Kassler (*op. cit.*, p. 27, n. 49) suggests John Seton's *Dialectica*, and identifies two copies listed as having been in the parochial library at St Mary's Church in Rougham. This library, built at some time in or after 1709, included RN's own books, as well as many volumes that had come to him - for example the books that had belonged to his learned niece Dudleya. The catalogue (according to the Norfolk Record Office Online Catalogue, item DN/MSC2/29), is dated 1714, it contains nearly 1,200 titles. A transcription of the catalogue will, in due course, be made available on this website.

2v

B. p^r[5]

I was to stay a year there, being thought E=
ough to Irritate My braines In order as others
doe, to sell their brilliant Escume. there I
was p^rferred to Burgersdicius[6] logick Where
I learnt.
<space left>[7]

And likewise had a touch of Metaphisicks
where I found out that Eus Est quod habet
Entitatem;[8] I had a furnier on y^e 6. books
of Euclid.[9] w^ch I read by My self, and won=
dred I could Not find out why Such stuff was
celebrated & Recomended; he that was Calle[d?]
my tutor, told Me If I ~~did not like it & were~~
was Not delighted with it, It was certein I did
not understand it; So I laboured on 'till I was
pleased, & having /once\ hold, /I\ could Never since
let goe, such Engaging truth's, w^ch are More
detach't from y^e wickedness of y^e world then
Justice ~~of~~ or Religion both ~~w^ch~~ /for they\ suffer Corruption
~~In~~ /under\ it. But all my penchant was after Na=
turall philosofy, they Called phisicks for out
of that I conceived hopes of understanding
the reason's of all thing's In Earth & heaven
too. A freind lent me Sennertus[10] phisicks w^ch
I read all over, and found Many dainty

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[5] RN's alphabetical numbering begins on this page, as does his use of a header ('p^r', an abbreviation for 'preface'). The alphabetical numbering has been crossed out in pencil by the BM curators in on the recto pages.

[6] Franciscus Burgerdicius (Franck Pietersz. Burgersdijk, 1590-1635) was a Dutch philosopher whose Aristotelian *Institutionum Logicarum*, Leiden, 1626, was a widely-used textbook in the seventeenth century (the Latin text was republished in London and Cambridge several times, it was even translated into English in 1697. A copy is listed in the catalogue of St Mary's Church library.

[7] A space has been left - perhaps to be filled, perhaps to indicate just how much was learned.

[8] i.e., 'That which is is that which has a being', this is written in a scrambled latin echoing the style of scholastic metaphysics. Whether this as a specific quotation has not been determined - but then I have not worked my way through Burgerdicius.

[9] *Euclidis sex primi elementorum geometricorum libri, in commodiorem formam contracti et demonstrati a P. G. Fournier*, Paris, 1654. Georges Fournier was a Jesuit priest, a ships chaplain, geographer and mathematician who also published on practical matters such as ship construction; he taught Descartes at La Flèche. The tutor referred to was RN's older brother Dr. John North, later Master of Trinity.

[10] Daniel Sennert (1572-1637) a German physician and natural philosopher. RN is probably here referring to his *Epitome naturalis scientiae*, first published in Wittenberg in 1618.

p^r^. ~~c.~~

determinations, as Iris est Reflectio solis
In Nube Concava; lumen est actus Corporis
diafani, Motus est actus extis In potentia
Quatenus In potentia.[11] & Such like w^ch^ I Could
Not controvert or Contradict, but Continually
suspected My owne understanding rather
then y^e^ Seeming sterility of my author. I
observed a Sort of Sly discours about Des
Cartes philosofy, as /being\ New and extraordinary
and found no Repose, till I had Made a pur=
chas of his works In. 8^o^.[12] & Read 'em over, &
over without any considerable light, but
Infinite wonder & pleasure, from the Novelty
& variety I found there. I was Inquisitive as
farr as I durst, to know the Meaning of
his Maine designe, as well as particular
applycation's, but never mett other Encu=
ragem^t^, then ~~frounds~~, /frownes\ & - why did I medle
with such ~~books~~ /Authors\. In short, I had Not Many
book's, & No lectures att all; a freind lent
his Name, as tutor, to enable My admission
but I read to My self;[13] So a litle phisicks,
mathematicks, the peacable side of logick

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[11] i.e.'The rainbow is the reflection of the sun in a hollow cloud, light is the action of transparent bodies, movement is the fulfilment of potential insofar as it is potential,' i.e., scholastic Aristotelian science.

[12] There were several to chose from - Antoine le Grands's octavo edition of the *INSTITUTIO PHILOSOPHIA SECUNDUM PRINCIPIA Domini RENATI DESCARTES Nova Methodo Adornata et Explicata. In Usum Juventutis Academicae* (i.e., with young men such as RN as the target readership) was printed in London by J. Martyn (noted on the title page as 'Regalis Societatis Typographum', that is, as printer to the Royal Society) in Latin and English editions in 1672.

[13] The 'freind' was his older brother, John North.

3v

D. p^r.

Some musick, & no conversation were My
Cursus at y^e university, and from thence I
was sent to shift in y^e world, In w^ch I had
as others My frisks & turnes at sea & land
& proved all that was good & bad in y^e
bustle of ~~an~~ /a very\ active life, But ~~Never So Much~~ /however\
Imployed or Retired, ~~but~~ I had /allwais\ a book ~~off~~
some sort or other within my reach. an[d?]
Now I am a grim sir in a Country farm
and ~~pass~~ /spend\ my time /partly\ Moving to & fro, ~~& Not~~ /partly\
~~a litle~~ Reposing In a hole by y^e Chimny Co[r=?]
ner with a round window Called a closet
where like an old bird /in an hollow tree\, I Rumenate My No[tes?]
of the generall perfidy but More Inexpressible
ffolly of all y^e feather'd kind in yon' forrest
And /whither I ~~am~~\ Walk~~ing~~ or Sitt~~ing~~ No sort of thinking is
So agreable to Me as /y^e speculation of\ Naturall thing's and
~~Resolving~~ the /ordinary but wonderfull\ ~~complex~~ phenomena /of\ ~~and Won~~
~~derfull effect's of Secret /Invisible\ causes, such as~~ light
/sound\ fire, explosion's, ~~sounds~~ &c. with the Interest
they have in o^r faculty's /and concerning y^e power of them and desiring ~~both to~~\; ~~and~~
~~both as~~ test
~~and Register of~~ /to Register as well as test\ my thoughts, I ~~am no less~~
~~pleased to~~ /am\ dress them In words & Sentences /whereby I\ ca[n?]
[~~find~~?] see how they look, and ~~If~~ /as\ I like, /Reject or ~~lay~~ Reserve's\ ~~set~~ them ~~by~~
~~till farther occasion~~ /for future diversion\; this /practise\ I have bin the More

p^r^. ~~E~~.

Inclined too, becaus I have Ever found I did Not
well know my owne thoughts, till I had /wrote &\ reviewed
them; and then for y^e^ most part, Mists fell away
and ~~I saw clearer My own~~ fondness & failings /appeared in a clear light\
~~It is~~ /is\ No small ~~security~~ /aSSurance Even\ of /(1)\ knowledg /it self\ ~~to keep~~
~~it Erect & stedy to have~~ the /(2)\ perpetuall checks
of Ingenious freinds, but it is almost /2\ Necessary
as what is to appear abroad; ffor Men ~~doe~~ /know\
No More ~~know~~ how their sentiments, ~~In the Man=~~
~~ner~~ /as\ they happen to Express them, will be accepted,
then they can Guess at their Readers complexions
And It is My unhappyness to ~~have None~~ /want\ such /helps\
~~at least in /conversible distance\ Such distance as Renders them In=~~
~~Conversible~~. Therefore ~~I~~ /am forct\ use the onely succeda=
neum,[14] My owne Reiterated self, ~~Hoping of that~~ /expecting thence\,
~~to have at least~~ /perhaps\, half a freind, such as it is;
I have bin often admonisht by the Duterai
phrontides,[15] (~~so to Name~~ /so ~~as I~~ thus\ my /~~freinds &~~ half freind is styled\ ~~onely~~
~~[....?] in~~
~~philosofy,~~) to forbear Scribling, ~~as~~ /as\ Not my talent,
That ~~knowing~~ /Even knowledg such as I court\ brings no profit, wast's time, di=
vert's buissness, and Mend's No man's condition
of life; and /and after all\ wrighting, without an Extraordi=
nary felicity of Style and plausibility of Subject
such as flatters, powers, faction's or folly's, is
much wors. ~~[here?] y^e^ other and better half freind~~
~~is~~

[14] i.e., 'substitute'.

[15] i.e., 'second thoughts', from Greek.

4v

F p^r

~~is wanting~~ /but all in vain\ ffor /to say truley\ I cannot /baulk y^t\ ~~resist y^t~~ ~~pleasure, a~~
[~~truer~~?] /the humour or rather\ vanity of wrighting /& y^e pleasure I find it\ affords. I doe Not excuse
my self more then men use for other vanitys /less reasonable\
/tho\ more Indulged. I know /well\ a fop-wigg, ~~Empty~~ fine
equippage, Idle company, keeping /Gaming\. drinking
~~keeping~~, swearing, /[~~...~~?] [side?] boxing faction politiks\ ~~Masking at y^e [p?]~~ & many o=
ther such ~~gentile~~ /fashionable\ Injoym't^t litle [hints?] pass mus=
ter, and doe Not Sully their ~~properly~~ /declared [...?]\, but If I
should appear, as they, barefac't, /in\ ~~with~~ this my /dull\
Solitary dress ~~about mee~~, I must Expect con=
tempt & scorne; therefore Since I mean Not to
compare my diversion's with theirs, I shall [~~wear~~?] /crave\
[~~cheap rather .. ..~~ ?] /leav to wear my\ mask ~~then W^eh Concluding~~ /and so hold my [counte=?]\
/~~at leas~~ Indemnifyed, w^ch concludes\ the acc^o Intended to give of My self next for my wares.

The circumstances of My education & Cours of
life will priveledg me in that Supine Sort of
wrighting called Essay's, being much of late In
use, Especially When Gentlemen Scrible, who care
Not to be confined to Such Strickt /order &\ method, as Com=
pleat tract's p^rtend too. They have thought's w^ch
must be vented, and they will Not take that pains
as is necessary In Composing well; ~~they~~ When y^e
worme works, they write, and ceas when the
flash is Gone. and Such is my case, ffor ~~In all my life~~, I have Ever bin Inclined to thinck on
y^e Subject's I here touch upon, and So willingly
as never to fail at a pinch to divert me,
they make Even want of Sleep /w^ch most hate to me\ a pleasure.

p^r^. ~~H~~.

Nor could I ever Shake off ~~that~~ /the\ fond opinion Most
have, y^t^ ~~what they~~ thinck/ing\ they understand, they think
also they can express /it\ more /clear &\ Intelligibly then ~~hath bin done by~~ others ~~but I must add that I am Conceited~~ /have done and then y^e^ next steep is to doctor it, ~~&~~\.
~~I have /as well\ Refined /as and\ added to a fancy No body understands so well~~. But My vanity goes farther I cannot but
thinck ~~I have thought with more regard to~~ In some
thing's I have thought farther then others ~~have done~~
and here & there added /some\ new discovery's w^ch^ ~~I think~~ /seem to fill\
~~worthy of being p^r^served, as~~ /divers ~~fill~~ blanks ~~In others~~ and lacunes /extant\ in philosofy and\ ~~that wanted~~ also observed
some failings In arguments and application of Experim'^ts^
worthy to be Noted & applyed; But What If all this
be as I ~~say~~ /suspect\ fond, vaine, & groundless? I am Not yet
Convinc't of it, and till then, I may be allowed My foible
on acc^o^ of Good will.

I doe Not ~~as Some~~ p^r^tend to Compile an Intire body
of phisick's; there are so many of them, they are ful=
some, and are but wrighting one after another, with
some variety, as y^e^ authors /In some particular things\ happen to differ frome
one and other. to find out, w^ch^ one Must have the fa=
tigue of passing over all that vulgar Stuff they are
ffilled with. It were well If many of them had Spared
y^e^ press, all but their owne singularitys, and proposed
them Onely, ~~who~~ with y^e^ subjects Concerned. This I have
designed to doe; that is treat No subject but such
wherein I thinck I vary /from\ or add /to w^t^ hath Gone before\ somewhat ~~fr~~
considerable. And I doe the rather decline the part
of a compiler, becaus I know it betray's men Into
shallow determinations, least they do Nor comprehend

5v

H. p^r

Every doubdt, and after rather then leav a Gap they
Insert the best acc^o they can find or make, altho
they are well Satisfied of None. It seem's to Me that
Nothing hath betrayed Great witt's Into more failing
then the design of Resolving Every thing. If they
would hold to what they bring New and clear to
their owne minds, as ~~y^e doctors of phisick p^rtend at
their~~ /their\ Nostrums in philosofy; books would be less
voluminous, the Improvem'^ts and advances greater
and Every ones propriety In them p^rserved. The World
is very buysy In Collecting Experiments. I thinck a
collection of thoughts would be very considerable. And
that is what I here propose, adding of others, onely
what I thinck may make my owne understood.

It may be sayd I take upon mee too much,
p^rtending to Add to the Arguments and disco=
very's of such Great Spirits as I Referr to. W^ch
Granted I have Not Much to ans^r for; facile
est Inventis addere.[16] and if y^e author's were al[ive?]
and spoke with. they would Encourage rather
then blame such understanding's, and None bu[t?]
y^e Impertinence of Critiscisme can blam it.

It will be also charged upon me that I use
too many words; ~~If I am~~ /and that a\ philosofer Should be
concise & sententious; I grant y^e shorter, If u[n=?]
derstood y^e better, and If length obteins that
the Excess is Not a Mortall fault. the contrac[=?]
ting, is after work; when Notion's have bin ve[n=?]
tilated, & adjusted among y^e vertuosi, then
they may, by such as have a dexterous pen
be

[16] i.e., 'it is easy to add to (i.e., to improve) something already invented', Latin proverb.

pen be Collected & contracted, ffor y^e benefitt of
~~learner's~~, /some\ who Care Not to dwell long upon any
thing. of that sort is le clerck's phisicks[17] w^ch
had he compiled without pricking in his owne
conceipts, y^t are the worst of y^e pack, the designe
was well enough Executed. But such as Invent
Especially in Matters of abstruse thincking, Must
be Copious, or obscure; & surely y^e latter is y^e Worst
fault; And to say truth, In such subjects, lan=
guage is defective, words are Not to be had to
Note the various Images In y^e Mind, so Recours is
had to scenes, alusions, perifrases, & figures
In order to make other's apprehend what we
thinck,

[17] Jean le Clerc (1657-1736), a Swiss theologian and scholar, published his *Physica, sive de rebus corporeis libri quinque* in Amsterdam in 1696. From RN's use of the word 'phisicks' it seems likely that this is the volume referred to. Le Clerc had been in London during the most turbulent months of the Exclusion Crisis in 1682, moving to Amsterdam where he became a close associate of John Locke. He would therefore be considered by RN to be neither a theological, philosophical nor political friend.

6v

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Phisicks.

The design here is to Shew the subject of Natu=
rall philosofy, Its method of proceeding, and some=
what of y^e^ office, & caracter of a Naturalist.

These philosofers like miners, first digg y^e^ oar,
& then Refine it, after w^ch^ it is Consigned to arti=
ficers to adapt for comon use. The oar is y^e^ Mass
of sensible things In y^e^ world, of w^ch^ some are all=
ways neer us, some ly deep, and cannot be come
at without labour and Engins, and the Richest
veines are out of all possible reach. our Notice of
y^e^ oar, that is externall objects, Is from our Senses,
but the Refining, that is distinguishing between
appearances and y^e^ truth of thing's, (for those are
very different) is y^e^ work of Judgment. vulgar
Errors, against w^ch^ Naturall philosofy aim's, hap=
pen ordinarily by attributing to y^e^ Object what
subsists onely In the sensation, and to sence, that
w^ch^ is the Result of Judgment; and partaging y^e^
truth among these jus suum tribuendo,[19] is al=
most consumate philosofy; ffor If either be over
or under appayed science is corrupted: here is y^e^
buissness of a Naturalist, w^ch^ will be best Expli=
cated by Examples.

1. Guilt wood, and Real Gold are In view Ex=
actly y^e^ Same; but y^e^ Naturalist having Experience
poiseth

[18] The pages have been renumbered from an earlier BM numbering. From f. 8r RN's own numbering appears, crossed out on the rectos in curator's pencil. The header 'phisicks' runs continuously from here up to f. 60. Although is possible that the headings were added later to some sheets, it is not apparent, and if it was added later, there are no instances of being done so hurriedly that wet ink was pressed onto the opposite page. Akso, it is easy to believe tht the ink used in teh header was that used in the first line of the text below. This suggests that even though RN starts and stops runs of his own numbering, he was from the start, and intentionally, combining it all in a continuous work: the 'phisicks'.

[19] i.e., 'to render each his due', this is a half-exact quote invoking the *Corpus Iuris Civilis* (Body of Civil Law), part of the revision of Roman Law undertaken by the Emperor Justinian (482-565). RN, in referring to this foundational document, which still shapes European legal theory, underwrites his own qualification (as a lawyer) to make such judgments.

poiseth Each in his hand and So discover's the
difference, and by farther proofs, that one is wood
& No other materiall, whose outside onely is Co=
vered with the Shinnest Gold.

A Country man sees. 2. trees, one larg & distinct,
the other more confused & small; he is ready to
pronounce that he discernes the latter ~~is~~ /to be\ farther
from him, then the other. and this he thincks he
knows by his Immediate Intuition; Not weighing
that his opinion is from Experience, and the meer
Image of y^{e} object declares ~~noth~~ No such thing.
ffor both may be so upon a picture-plane Ex=
actly Equidista~~t~~nt.

Two Globes are plas't on a line verging from
us, and that remoter, is made larger then y^{e} other
as the distance. The Image of these 2. Globes
seen under Equall angles, and so making E=
quall Impression on y^{e} sensorium, are Exactly
equall. but yet a Country man shall say he
discernes the farthest to Exceed the neerest; ffor
experience having setled an opinion, that ob=
ject's lessen according to distance, If in such Case
they appear Equall, The Inequality is as Manifest
as In any case it May appear to sence. ffor The
opinion is setled without any Reflection upon
the

condition of y^e^ view; w^ch^ Shews that advertence
is Not allwais necessary, to y^e^ use of Judgm'^t^, and
that is the part of a philosofer; ffor he and a
country man shall have y^e^ Same judgm'^t^ upon
such a view as here is stated; but y^e^ one thincks
he sees, & y^e^ other Not onely sees, but Judgeth,
and so knows how ~~it is~~ that appearances affects
him.

Wee are almost Continually sensible of various
sounds & colours, are from thence doe admire
the wonderfull beauty's of the Externall world.
But the Naturalist finds reason Enough to con=
clude all those Images or fantasmes In the sence,
to Reside onely there, and Not abroad In the ob=
jects themselves, w^ch^ onely by simple motion are
the caus of them. as (to use a gross Instance, Sup=
posing, in this Respect, the most delicate sen=
sation's to be all alike,) paine is Not In the
Cudgell y^t^ Inflicts a stroke; Nor In a sword that
Stabbs; No More are those conceipted Glory's of
Exterior things In them, but In the sence onely.
And this thought is so generally Received, that
I need make no apology for it as undermin=
ning a great argument of providence: altho I
thinck Not so of it; but rather y^e^ Contrary, that
the ordonance of animalls & their sensitive
organs

Organ's In such manner, that from ~~such a~~ /so\ Jejune a
caus as simple motion, those lively & Glorious Ima=
ges should proceed, is a Greater Argument for Provi=
dence, then y^e^ whole world with more ornaments
then Ever fancy bestowed on it, could be.

These Instances may Suffise to Shew, that it is one
of the most difficult works of philosofy, to dis=
tinguish things Into their severall natures, so as
they may Not be confounded, and one taken for
another; the rather becaus It hath p^r^judices, &
those of Earlyest Education, & hardest ~~to R~~ of
conviction to Remove. ffor men in generall are
not Easily brought, even though they desire & Intend
to abstract their first Conceipts, and Consider things
freely and Indifferently; Not onely uneas/y\~~ily~~, but
loath to come to it, In a degree of sorrow or an=
ger, at parting with an old fancy, as for an old
freind. Therefore it is to be say'd once for all, that
whoso cannot Conquer this Informity and become
Indifferent to /entertein all\ to Novelty, /In Naturalls according to reason,\ with as
much Eas as Com=
mon things are deliberated, may lay aside philoso=
fy & take to somewhat els.

As to object's themselves (for the discours of our Man=
ner of perceiving them is of another place) the prime
care is to distinguish between the Essences, and their
Effects

Effects, or necessary Consequences; Els great confu=
sion or Incerteinty of thing's will enter. And much
of this failing will appear due to an Imperfecti=
on of language; as for Example.

It is ordinary among our Naturalists to p^{r}scribe
a mentall devesting the Corporeall world of all
y^{e} Images of fantasmes wth w^{ch} our senses dress it.
and then to observe that Nothing will Remaine
but space, and what fill's it, body, whose onely
and Essentiall property is hardness, and In hol=
ding place Invincible. More then this is Not gi=
ven us to know of that Essence that Consitutes
all y^{e} objects of our sence. And this state of Body
Supposed. there follow's, that it is devided, It chan=
geth place and posture, Each part hath some
shape, as also proportion to others /& y^{e} like\; Hence In lan=
guage, becaus wee cannot be so prolix to say the
same things over and over againe on all occa=
sion's, wee abbreviate by using words, In abstracto.
as Quantity, Motion, figure, Ration, & y^{e} like. w^{ch} are
very Necessary and usefull, provided wee doe Not
laps into y^{e} Comon failing of conceiving these
abstracts, as essences, and Subsisting distinct from
body. but when wee conceive any of them it be
allwais

allwais attended with y^e Idea of the subject Matter
It depends on. There is litle danger In some of
these, but in others very much, and of ill Consequence.
and In particular that of Motion. When wee Con=
sider a figure, wee readily allow it is Nothing a=
part from y^e body figured. but when wee Consider
motion, tho wee take along the body's moving,
yet wee cannot but ascribe some Essence to Motion
apart from body, as If it Could be in, or out, here,
or there, & y^e like. The Caus of w^ch, wee have Images
of force & action Relating to our members, y^e Move=
ment's of w^ch are often attended with some attention
or order of thought, and without that are Most
Inclined Not to move, but, as it is termed, Rest;
And these Images wee transferre to Body's without
us, as If y^e Same spirits posses't them. Whereas In
truth Nothing can be truely affirmed in Cases of
Motion, but that body's chang distance or posture
With Respect to Each other, and that of this Motion
is onely a terme, In abstracto, as figure & y^e Rest of
that sort are.

And those who from More Complex object's and Effects
Collect certein modes of such changes, & giving
them Names, use those words, as for reall Essences,
are authors, of Inextricable Error. Such as vis attrac=
tionis, vis centripeta, vis centrifuga,[20] & others
of y^e

[20] i.e., 'attractive force, centripetal force and centrifugal force', i.e, Newton's cosmography.

of the same Sort, Not Secrets In this age; all w^ch^
have no Signification att all, but as Joyned with y^e^
Image of y^e^ thing to w^ch^ they belong. as for Instance
that heavy things discend by attraction of Gravity.
What is that attraction? If they say, as they would
have beleeved, that body's are Endued with a force
of Coming together, ad Mensuram densitati.[21] then
they set up a principle, w^ch^ wee defer to another
place. If they mean from other Causes, but from w^t^=
Ever caus it is, they Call /y\~~i~~t /effect\ attraction; then they
Say heavy things discend by the Coming together
of Gravity, and so talk nothing In the forme &
disguise of something.

But the truth is Such words are set up onely as
a screen or fucus[22] to cover a designe. so Aristotle
who would Not Concurr with any philosofers
before him, and yet would advance himself In
fame Superior to them all; turned all Naturall
philosofy Into an art of words; as is well knowne
by that single one Quality, Ever since used by his
followers, to ans^r^ all Question's, & y^e^ Craft lay In
this, that a science of words Can never be Confu=
ted; becaus y^e^ sence is arbitrary, and If you take
them In their Intention, you admitt their sence, &
there's an End. but thing's will Not Buckle so,
And If you leav y^e^ word, & ask of the thing, y^e^

---

[21] i.e., 'in proportion to their density'.

[22] i.e., 'deceit', 'trick'.

fucus dropps off, and ye Nakedness appears. as when
one say's, Motion is a Quality, &c. In ye first place
for ye Motion, you Must goe to some body's changing
place, & hold them sure; then for Quality, what's
that? Nature hath Not a thing to answer ye Quere,
& so it must dropp.

It is No better In this New model of attraction;
ffor what is the difference, between vis, & Qualitas
unless it be shewed what ye Reality of one & other
is? It suffiseth Not to say, whatever ye Caus is,
vis is a proper word,? true, when it is not used as
a principle, but onely an abstract. and So is place
time, motion, Gravity, & what of that sort Not? But
If these, without attendant Essences that sustein 'e[m?]
brought into Reasoning, Make No solid structure
Much less, what is held forth, a foundation for a
process of mathematicall demonstration, Concluding
ye whole state of Nature.

Another advantage is had by this distinction of
Essences, and effects, is the directing Inquiry's after
Efficient causes. ffor such things as have essence
in themselves, as first In generall body, then the
modes, & finally ye aggregates, ffall not properly
under such Inquiry. ffor however ye Modes & aggre=
gates had a begginning, and that beginning May,
In some cases be shewed; yet being as they are ~~need~~
~~no~~

No efficient Caus is Needfull to support them. body
it self had a beginning by Creation, and there Needs
No reason farther be given of its Continuance. ~~So~~ /Its true\ the
modes and aggregates ~~might from~~ /by succeeding\ alterations /might\ have
a latter begginning, but that is Not to be Inquired
as a Caus, but as history, ~~And that~~ /w^{ch}\ is Not Incumbent
on philosofy to account for. It is therefore Imperti=
nent when any ask's as many will, [or?] as weakly,
why is this place rocky & that sandy? why this
an Island, & that a Continent? Why an oak bears
a different leaf from an Ash? & y^{e} like. ffor the Na=
turalist takes thing's as they are, and hath to doe
with Nothing but their changes, that is their Con=
sequences or effects, or y^{e} essences, In order better to
Investigate the changes. Therefore all Questions that
concerne chang, are proper Inquirys /In the way\ of a Naturalist
as, the Event's of Motion, the Efficient Causes of
light, Sound, heat, & other sensation's w^{ch} are the
Consequent Effect's of such changes as happen, among
reall Essences.

Cartesius sought to make his thought of Motion /No\
/otherwise\ continuing /then\ as Rest, /continues\ till Interrupted by some Effici=
Ent Caus /to be more\ plausible, by Referring to figure; supposing
as must needs fall out, men would Readily Imagin
that a square or round trencher would Continue

So for Ever. If Somewhat Efficient did Not alter them.
so motion &c. but this was bu Insinuation, & No reason,
ffor the Question Returnes Equally upon the figure, or
any other mode, nay ye Substance it Self, as well as
any mode of it. Ex Nihilo Nihill fitt,[23] is alledged to
prove that a being cannot caus, no more then Create
it self. Now /agt that ~~axto~~ axiome I say those two are\ ~~I thinck that~~ Not ~~to be~~ ye Same
~~thing~~; for
creation determines the thing, and also certein Modes
of it, wch argues some act or will positive. ffor No body
can subsist but ~~in~~ /under\ certein Modes, and the Question is,
wch? and yt must be determined, in ye act of Creation.
But ceasing to bee, is a negation, & Nothing positive,
and may be by the ceasing of a will, without ye act.
Therefore the account of all Essences, wch are ye Subject
of Naturall philosofy is this; that Their creation and
continuance, is the Result of ye same will, wch is Quasi
a perpetu/a\ll act. and that thing's /are, and\ Continue, ~~& are~~,
are Coincident proposition's; therefore /fall\ without the
Sphear of philosofy; however I thought fitt to touch
thus much metaphis~~a~~/i\cally upon them, becaus such as
doe Not well distinguish, are apt to blunder into Im=
proper Inquiry's. And It may be hereafter, discoursing
of principles, & ye Nature of time, this may Receive
some Confirmation.[24]

So Much of ye Subject, and In part the method of Na=
turall philosofy, It remaines to Insinuate somewhat
of ye Caracter, & behaviousr of a Naturalist, ffor the
Mistakes

---

[23] i.e., 'nothing is made of nothing'.

[24] The larger context for these observations on the 'metaphisical' issues was the debate concerning the continuing activity of God's active creation, or providence, in the world, notably as developed by Nicholas Malebranche (1628-1715) with the concept of 'Vision in God' and 'Occasionalism'. The topic returns below.

phisicks ~~200~~ ~~11~~

mistakes Relating to them, as have befallen In y^e^
conduct of most, Especially y^e^ most Eminent & Capable,
have made y^e^ Science it self, depreciated as frivolous.

1. As to knowledg, it is an Error to p^r^tend to more then
is possible ffor humane kind to arrive at; and this is
seen by a readyness In most to ans^r^ all manner of
Question's, and never to say they know Not, but rather
pay with abundance of Insensible words, w^ch^ have
no true Image Couched to warrant them. this is Wors
then being in y^e^ wrong, ffor ~~iff~~ y^e^ words have/ing\ signification
It may be Judged, If there be error, or Not; but ~~If they~~ if
~~are but~~ an Insignificant chime /onely\, more paines are Im=
ployed In studying ~~them~~/ir\ /Meaning\ then In finding out a truth.
Thus the Great Aristotle failed who aiming to Resolve
all Question's & to be Confuted In None, Erected a fabrick
of words, ~~that~~ /w^ch^\ Informed Nothing. and the No less Cartesius
who was ambitious of Giving a Mechanicall Resolution
of y^e^ Magnet, and of light, &c. ffell Into such meer
hypotheses,[25] of subtile matter, as Exposed the Rest of
his thought's to great disadvantage, ffor when folks
fell so roundly to y^e^ Denying of those, they struck
thro y^e^ whole. And the latter S^r^. I. Newton,[26] to obviate
that Imputed Ignorance, Invents powers, and with
them Solves all things. But for y^e^ more Shallow p^r^=
tenders, ffew are unacquainted with y^e^ affected Jar=
gon of words they tho out when they Miss y^e^ Matter.

[25] The word 'hypothesis' (variously spelt) will return again and again in these MSS. It is worth recalling the OED etymology (Greek ὑπόθεσις foundation, base; hence, basis of an argument, supposition, also, subject matter, etc., < ὑπό under + θέσις placing>), which implies a technical or neutral term, as might still be the case in usage. For RN, who prefaces it with the word 'meer', the OED's definition 4a seems always implicit: "A supposition in general; something supposed or assumed to be true without proof or conclusive evidence; an assumption". (OED online consulted, August 2014)

[26] This reference to Newton's knighthood enables us to date this manuscript to after May 1705.

12. phisick

2. As to language, the affectation of unusuall words, is
both a snare to y^e^ Naturalist, making him fancy there
is somewhat coucht In them, when In truth there is Nothing
but also a fastidium[28] to y^e^ hearer. therefore it is best in
philosofy, as In all cases whatsoever, to use y^e^ most
vulgarly understood termes, and Expressions, as may be,
ffor Matters so farr out of the Comon way of thincking,
cannot be Expres't too plaine, and after all it is not Easy
to Express what wee thinck, so as to be understood by those
who are not used both to matter & style. and yet there
is to be a moderation & Respect; ffor some thing's have
not any vulgar word to Express them, w^ch^ is y^e^ Case of all
art's, w^ch^ for Compendium of speech, use peculiar termes,
so philosofy must have its termes, w^ch^ Cannot readyly be
translated, or Not without too Much length. and however
that some words /of art\ may seem to have a correspondent
terme in vulgar, yet it is found such doe rather obscure
the clear the Expression; as for Instance pha^e^nomenon
is Not duely Expres't by y^e^ word appearance. Nor Is y^e^ Same
Notion conveyed by y^e^ latter, as y^e^ former Carry's. therefore
there must be in some sort a philosoficall style, w^ch^ used
with care & modesty, may be Excused, if It it trans=
gress vulgar Expression. but y^e^ worst of all is the affect=
ation of old obsolete words, of w^ch^ If one may Judg
as I thinck best done by y^e^ Extremity, take M^r^ Farfax
book, of y^e^ bulk & selvedg,[29] that is magnitude & limit.
of

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[27] There is some marking from what appears to have been the effect of water throughout this essay (it is written on a substantial and opaque paper); on this and the next two sheets the marking is worse, with some chalky white marking (like an efflorescence, or even like white paint), too. On the last page (14v) the marking carries over onto the following essay which, it would seem, has not always been an adjacent sheet, since the earlier numbering in pencil is not continuous (even though the marking suggest a longer, previous, historical juxtaposition).

[28] i.e., 'distasteful'.

[29] Nathaniel Fairfax (1637-1690), *A Treatise of the Bulk and Selvedge of the World; Wherein the Greatness, Littleness, and Lastingness of Bodies are Freely Handled*, etc, London, 1674.

of the world. ffor he aiming to decline Greek & latin
and use onely proper English words, falls so Into the ~~same~~
Anglosaxon Idiom's & compounds, as would Make one
admire as well as pitty. ffor Arithmetick is tell-craft,
w^ch^ is tollerable; but what say we to unthoroughfare=
someness fo Impenetrability? Here are y^e^ Extream's,
& It is allwais Noted y^e^ vertue Resides In y^e^ Means.

3. It is very Necessary for a Naturalist to have a Nice
and Quick, as well as just observation of all occurrences,
ffor ffew thing's happen to ordinary view, w^ch^ Collated
with other sensations, or y^e^ Memoires of them, doe Not
afford some discovery, or Confirmation, If Not Confuta=
tion' of what was thought before.

4 The Naturalist Must Not be greedy of fame, Nor
be adherent to sect's, or party's; No More then ambi=
tious of being a leader himself. but Remember allwais
that, what ever Engagem^ts^ May happen, Still veritas
amicissima.[30] Many have suffered upon this shelf
and of those, the most Eminent, ~~In greatest degree.~~
Aristotle is observed to Cite Many of the philosofers of
hi~~m~~s and y^e^ p^r^ceeding time. but never approved or a=
greed /In any thing\ with any of them, ~~In any thing; and that~~ /It was\ am=
bition of /fame &\ superiority /y^t^\ betrayed him Into that chimeriq
Structure of phisicks, y^t^ held y^e^ world so long, & then
fell to pieces. cartesius cannot but boast, and In
cases

[30] i.e., 'truth is a greater friend'.

cases, y^t least becomed him, that is his application of y^e
subtile matter. Hobbs whose Witt exceeded his skill, In=
tended to be read in y^e university's, & failing of that
was half distracted. The late ~~M~~^r S^r I. Newton,[31] Inferior
to None, seem's to have spent his whole Study, Geome=
try Excepted, In confuting cartesius; and takes all oc=
casions to Slight him, as when he Makes him in y^e Matter
of y^e Rainbow a plagiary of Ant. de Dominis,[32] a Wretch
without fellow. Whither he had y^e hint from him or Not /I know not but am sure\
~~It is plaine, that~~ the passage is not set in without a
pleasure, here are examples enough of that devious
failing of philosofer's in y^e Way of Confidence and va=
nity; And I cannot but say, I Never knew a Great
will & vertuoso free from it but one, ~~who~~ /& that\ was y^e most Ex=
celent D^r. Barrow.[33]

5. The last Qualification necessary to a Naturalist, I
Shall Mention is that of a Geometer,. I Mentioned artifi
cers, to take y^e /Refined\ oar and shape it for use, & those are y^e
Geometers, and their pages y^e mechanicks. But I must
attribute more to Geometry, 1^st. as it is the Greatest
accomplishm'^t of y^e rationall faculty, and habituates
the mind to weigh & discerne the strength or weakness
of proposition's and to be tenacious of y^e one, and /to\ Re=
ject y^e other; y^e is an admirable p^rparative against
p^rjudice. and then. 2^d. when y^e Naturall principles
are ffixt, and measures come in play, Geometry is at
home, and must take y^e helme, & steer y^e whole process.

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[31] This is unlikely to be a post 1727 MSS, so it seems likely that the joke is on the late 'misterhood' of Newton, rather than any reference to his death. But …

[32] Markantun de Dominis (Marco Antonio de Dominis, 1560-1624), Croatian Jesuit and Bishop, formerly a teacher at Padua and elsewhere, who abandoned Rome and settled in England under the protection of James I. He subsequently returned to Rome where he was imprisoned by the Inquisition. He was the model for the corrupt Bishop of Spoleto in Middleton's *A Game of Chess*. Newton's claim that De Dominis was the first 'correctly' to describe the refraction of light in raindrops as producing the rainbow has since been itself corrected, and Descartes is now granted ownership of the idea.

[33] *See* note below, f. 159r.

phisicks ~~202~~ ~~15~~.

Therefore the Naturalist must Not be a Stranger to
Geometry, and altho theat science is Not Coincident with
Naturall knowledge, yet it is so usefull, the more of it
a Naturalist hath y^e^ better, unless he be so overrun
with the language and dress, that he can do or Say
Nothing In other forme, as hath sometime happened, then
it is an Incumberance to philosofy rather then an aid.
As for Instance where y^e^ discours is not founded on simple
Quantity, but on Complex Systemes,not geometrically
defined, as fluids, fire, meteors, & y^e^ like, how is it pos=
sible to move in geometick forme analitick or synthe=
tick? Nay, I will give a bolder Example. the arbitrary
assumption of any line ~~as mixt of~~ /described by\ 2. movements
as y^e^ diagonall of a paralellogram; I Conceiv /as\ Not a
legitimate Ground for demonstration. ffor I am Not
bound and will Not condiscend to any such supposall,
for as it is y^e^ diagonall of one, It may be of 1000, & w^ch^
shall be it? And upon this, cartesius, & all since have
demonstrated y^e^ angle of Reflection Equall to y^e^ angle
of Incidence, & S^r^. I. N. makes it his principle of all Me=
chanicall powers. I deny Not but there is In the
discours a Congruence with the proposition's; as many
way's will aggree in describing a truth, and yet None
amount to a Regular demonstration; for truely In
phisicks there is No demonstration w^ch^ is Not Ex Na=
tura rei,[34] w^ch^ that is Not.

[34] i.e., 'from a natural occurance, or thing'.

14v

16. phisicks

But when y^e^. dignity of y^e^ subject matter is the Question
I must p^r^ferr phisicall knowledg to Geometry as y^e^ pri[or?]
and superior. ffor y^e^ very principles of Geometry are
phisicall truth's, and particularly the Nature of Body
Extended in longum, latum & profundum.[35] Here Within
this word Extension, ly's all y^t^ belong's to Geometry,
w^ch^ is an art of Measure, & nothing Els, and doth Not
discover any truth but In y^e^ termes of More, less, or
Equall. But all the knowledg is phisicall; It is No
News that Every block conteines all possible rations
& proportion's; and It were the same thing If y^e^ limits
of y^e^ block were Empty, or filled with Mettall, or stone.
It is the work of a Naturalist to verifye y^e^ substance, &
of Geomet~~ry~~/er\ to Make y^e^ account, & so these differ as
merchant & accountant; you May Judg y^e^ More worthy.
But as to y^e^ hurt done by Geometers obtruding principles
upon Naturall philosofy, I shall shew under that head.

[35] i.e., 'length, breadth and depth'.

15r

phisicks. ~~1~~.

/The designe here is to shew
y^e^ Subject of Naturall philo=
sofy, & the ~~cara~~ /office of\ a Naturallist
with y^e^ Capacity, and caracter of both\

Naturall philosofers, like miners, first digg y^e^ oar,
& then Refine it; after w^ch^ it is left to artificers to
shape ffitt for uses. This oar is the mass of sensible
thing's in y^e^ world, of w^ch^ some are allwais neer us,
some lys deep, and are not to be Recovered without labour
and ~~y^e^ assistance of~~ engin's, and ~~much~~ /after all y^e^ Richest veines\ ly's out of all
possible reach. /Sence shews us the oar, but\ Refining is y^e^ ~~Result~~ /work\ of Judgm'^t^ ,
and /consists in\
distinguish~~eth~~/m^t^\ /between y^e^ truth of objects, &\ the sensitive Images or fantasmes
of
~~occasioned by External objects, and the objects them=~~ /them; ~~ffor the appearance is~~
~~changeable, but things~~\
~~selves, such as, abstracting all sensitive beings, they~~
~~must be accounted. The~~ Vulgar Errors, ~~of humane~~
~~life are such as~~ happen by attributing to y^e^ objects
what belong's onely to y^e^ Sence, and to sence alone,
that w^ch^ is y^e^ Result of Judgm'^t^. And ag^t^ these /errors\ Na=
turall philosofy is principally aimed, and Works by
partaging the pha^e^nomena of Nature, ~~jus suum~~
~~Cuiq Reddenda,~~[36] ~~among those. 3~~ the object, Its
Appearance, and the Judgement /thereon\; Either of w^ch^ over
or under [appayed?], Corrupts science. Here is the
Great work of a Naturalist, w^ch^ will be best Expli=
cated by examples.

Guilt wood hath the same Image upon view, as
reall Gold, but y^e^ Naturalist, ~~whi~~ with his Experience
& poising it in his hand, discovers the disguise; first
that it is Not gold, & then by other proofs, that it
is wood, Guilded over.

A country man sees. 2. trees, one larg & distinct
& y^e^ other small & confused; he is very ready

---

[36] i.e., 'jus suum cuique reddenda', 'render unto each that right which is his own' ("'*suum cuique*' is our Roman justice", Shakespeare, *Titus Andronicus*, I, i.).

2. phisicks

To pronounce, ~~that~~ he discernes that y^e^ latter is far=
ther off. Not weighing at all, that his Experience
let him In to that knowledg; for y^e^ Meer Image de=
clares No such thing, but /yet\ without /any\ Reflection he Judgeth so.

Two Globes are placed In a line trending from us
and the farthest is larger, as is y^e^ distance. The Image's
of these two, seen under Equall angles are Equall,
but yet, the Countryman shall readily declare
he plainely sees y^e^ neerest is Not so larg as y^e^ other.
and Never Reflect's, that becaus at divers distances
he Expect's a deminution, Equality, In such case,
hath y^e^ Rep^r^sentation of Excess in y^e^ More Remote.

Wee are almost Continually Sensible of various
sounds & Colours, and therefore are in great ad=
miration of the beauty's of the Externall world.
The Naturalist finds reason Enough to conclude
all those to be but Images or fantasmes of sence,
and not subsisting In y^e^ objects ~~that~~ /w^ch^\, by simple
motion onely occasione[37] them. as (to use a gross
Instance,) paine is Not In y^e^ Cudgel that Inflicts
a bruis, or In a sword, that stabbs. Therefore the
Beauty's of y^e^ world, are falsly ascribed to Ex=
ternall thing's, and Resident onely In our Minds,
however no less admirable, and strongly arg/u\ing
a providence /then If they were in y^e^ object\ as to a Reasonable thinker Will appear.

These Instances may Suffice to Shew that It is one
of the most difficult works of philosofy to destin=/guish\
things Into their true posts, the rather becaus
It hath

[37] the 'e' has here been washed out.

phisicks ~~3~~

It hath pʳjudices, and those of Early Education,
& hardest of conviction to Remove. ffor Men In
generall are not Easily brought to abstract their
first conceipts, and to consider thing's Indifferently,
Not only hard, but loath, & Not without Sorrow
or anger /are scarce\ drawne to it; therefore it is to be Sayd
once for all, that whoever Cannot devest himself
of all pʳconceived opinion's, and Indue any others
pʳsented, ~~so as~~ /and like\ an Impartiall Judg, yᵗ Never was
touched with Either, Examine both, must Not pʳtend
to Naturall philosofy, but ffollow other affaires.

As to object's themselves, It is a principall Care, to
distinguish between Essences, & consequences, or Effects /such as\
~~wᵉʰ~~ necessarily flow from essences, according to yᵉ various
modes of them, and those Modes are also to be dis=
tinguish't from reall things, Els Strang confusion of
knowledg will fall in, and Nothing be truely taken
for what it is; for Instance.

let yᵉ Corporeall be divested of all yᵉ fantasmes
of our sence, with wᶜʰ in vulgar Notion it is drest.
And wee cannot say any thing Remaines but that
wᶜʰ fills place, and the space, or Extension that
conteines it. and then wee goe on to perceive this
matter (so Inexpugnable as to place,) ~~is~~ broken Into
part's, and shifting to, &, fro, wᶜʰ wee call Motion.
and consequently /that it\ is capable of various Magnitudes
figures, position's, distances, &c. but all yᵉ while

the

16v[38]

the onely Essence is y^e^ Impenetrable matter, If the
Rest Exist, it is but as modes, and are Not Necessary
to the Essence, w^ch^ ~~as well~~ /subsists\ as well ~~subsist~~, without
as with them. and to Say truth such are In No sort
to be accounted Essences apart from y^e^ subject Matter
as the figure is nothing apart from y^e^ body but a chi[=?]
mera of our imagination. And that w^ch^ leads Much
Into Error's of this Sort is the abuse of language; for
wee use words in abstracto, as figure, w^ch^ signifies
really Nothing, unless wee take y^e^ body along &
say a body of such figure; So for Motion, y^e^ Word sig=
nifyes nothing Els but a body changing place; and
y^e^ other will as well subsist apart from body as
that. But These abstract's with many pass for Es=
sences, and so they work up errors with them accor=
digly. What is more in Request Now then to al=
ledg powers, such as attractio, vis centripeta vis
centrifuga, & many others ejusdem farina^e^?[39] & If wee
say power is nothing, /then\ they must shew us the thing
that hath y^e^ Essence of power, /but as to that\ they are at a loss.

Another advantage lys In this distinctionof Essences
from Effect's, or Consequences. It throws off most of the
Impertinent Inquiry's are made; Such as why is
this hard? and the like, since Nothing more belong[s?]
to Essence, then that it is. So for y^e^ modes, to Say
why is this round that square; this move/ing\ that at
rest, this Great, that small? altho some of them
may be produced as consequents of others, yet.

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[38] There is some water damage to the bottom of this sheet, with rather more to the following sheet. The paper is robust and opaque and has survived the damage well, but the ink has been washed off in places.

[39] i.e., Newton's attractive, centripetal and centrifugal powers; 'of the same flour', i.e., of like kind.

phisicks ~~5~~

It is Enough that they are so at p^r^sent, and being
so must continue, till some efficient caus makes an
alteration. ffor continuance is Implyed In y^e^ Notion
of Essence, and the Essence hath all its modes, to Con=
tinue with it; so that the demand why any thing
that is continues? can draw no ans^r^, but /that\ the power
~~that~~ /w^ch^\ first made it, makes it Continue. And on that
Rest's the great argument for providence afforded
us from the Contemplation of Nature. that No rea=
son Can be given for Continuance, but an Eternall
will, with power as well to ~~make~~ /create\ as prolong the
duration of it, after it is created. The Cartesian
reason is not sufficient, saying thing's cannot al=
ter them selves, w^ch^ is true, but goes Not to Conti=
nuance; for Ceasing to be, and changing Essences
or Modes are 2. things; and ~~abolition~~ /extinction\, is No chang
of the thing; And altho wee have No ~~Notion~~ /Idea\ of anni=
hilation, and can conceiv No ~~More possibility~~ /other means\ of that
then of creation; yet If wee consider well, wee Must
allow a difference between ceasing & creating; the
latter carrying somewhat positive not In y^e^ other,
and ~~it Must not onely create but forme, y^t^ is deter=~~ /creation determines not onely of
thing but also\
~~mine~~ of Modes. &c. ~~whlile~~ while ceasing determ=
ines Nothing positively New, but concludes what
was Into Nothing. /But\ ~~And~~ It is scarce possible to distin=
guish between raising thing's by power and Conti=
nuing them; ffor when we consider /*\[40] y^e^ Nature of
time, wee shall find No reason, to annex that to
[........?] y^t^ depends on Not on body; but that
creating

[40] The following marginalium runs down the LHS margin from top to bottom: 'And whereas continuance is made a sort of axiom, it hath No other foundation but our Ignorance of y^e^ contrary; and that is no [~~controul~~?] /rule for\ things; and therefore a caus is [..?] far from being necessary to annihilate, I thinck there must be a continuall caus to Support [...?] first that they are, is No reason they S~~hall~~ /must\ Continue'. It is not clear whether this marginalium relates to this asterisk, but it seems to make sense that it does.

creating & continuing is but one & y^e^ Same act.
I doe but touch these metaphisicall points, becaus
some may say wee In our method pull downe, what
I thinck wee build /up.\ more Eminently then Ever was
done before, argum^ts^ for the devine providence.

The practick [~~..~~?] Cours of Naturalists of arriving
at the knowledg of thing's, devest of fantome,
must be through sensation, altho /even\ that /at best\ is but fantome.
[marg][42] but by contriving to have divers sensation's of one
& the same thing, and comparing them together,
The Judgm'^t^ hath whereby to determine of More
then any sensation whatever could shew. and this
method is called Experiment. And If this reiterated
sensation cannot be had, wee bring the neerest like=
nesses wee can, & compare them, and So gaine a
foundation; This will be More clear from Example.

If things are too small to be discerned with y^e^ bare
Eye, there are helps found out, with dioptrick Glasses
to descry things strangely deminish't. And the same
serves to help us foreward, when thing's are by
Immeasurable distance lost to sence; And with these
helps wee have New worlds of [animalenly?], as well as
the old made more knowne to us; ~~as every one knows~~.
Then as to ordinary things, wee see, feel, tast, heat
cool, burne brais & torment them Multifarious ways,
and by Comparing the sensation's of Each argue
many things to be true, w^ch^ were not without Such
paines to be found out; and of this sort of Handling
the

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[41] White mould on page.

[42] marg: 'experm^t'·

the Chimists are professors, and have ffurnished Much
In y^e^ way of philosofy, and of them None Comparably
with M^r^ Boyle. And when these generous observers
as he ~~hath done~~, comitt their discovery's & Remarqs
to wrighting, they Conduce much towards compiling
a Naturall history, then w^ch^ Nothing is more ~~Expedi=~~ /conducing\
~~ent for~~ /to y^e^\ advancing /of\ Naturall Knowledg. But as yet
Naturall history is very Imperfect; And to say truth
If that were to be Expected, as wee wish it Might
be Compleat, before wee take any measure's In a
philosofick Cours, wee Might Stay ad Grecas Calen=
dass,[43] and Injoy countryman's philosofy and ~~Non~~ No
More. therefore the Royall society, whos propose
onely to Collect Experiments, and to Medle Not with
the cours of Nature, ~~as~~ they ~~Mean by~~ /Call\ Hypotheses; untill
they have such a body Collected, as May Institute one
Compleat,. /are In y^e^ wrong\ And /no less\ those /also\ who hunt Nothing but laws
and property's of Imaginary powers, such as attrac=
tion & y^e^ like, ~~as I have to be opposed here~~ /~~not seldome~~ of frequent mention\, And
pro=
fess Not to Medle with Efficient Causes. That is to
Jogg on In Ignorance, & Never Intend to know, ffor What
is naturall knowledge~~s~~, but /that\ of thing's & causes? /This\

~~The Next destruction is of the Experiments and y^e^~~ /method Seems Most of any to hinder
knowledg, ffor they\
~~Judgm^t^ thereon~~ /take into their\ discourses termes that carry a p^r^judi=
cate Sence; as Attraction for Instance, the Comon
people thinck they understand somewhat by that
/word\ as when they say the sun attract's y^e^ May dew, and
therefore

[43] i.e., 'at the Greek calends' (more usually 'ad calends Graecas'), i.e., never.

~~therefore~~ fancy the sun will lift up an whole Egg
full at Noon day, but In truth Nothing ~~at all~~ is
~~so truely understood~~ /at y^e^ bottom\; but ~~they~~ /men\ are willing to accep[t?]
the Word as /already\ Current amongst them, ~~and stopps far[=?]~~ /tho In very different\
~~ther Inquiry~~ /acceptation\. therefore philosofers Should Not use
vulgar words, but where they Mean, as y^e^ people
to whom their discours is directed Mean. ~~These~~
~~latter palliate their~~ /But this\ proceeding /is palliated\; first by Saying, wha[t?]
Ever y^e^ Efficient caus is, their vires[44] are y^e^ Same; w^ch^
is utterly denyed, for a vis from one Caus, will Not
be admitted to act as one from another, ffor should
not the effect answer y^e^ Caus, & vary as that doth
Then they say y^e^ /method of\ phisicks ought to ~~be~~ /lead\ from property's
to principles, and Not from principles to property's,
for, ~~say they~~, If you argue property's from principles
you may, by proof, be Confuted, true but then you
must Not abuse science by /using Meer\ words, /In y^e^ sence of things\ as they that use
y^e^ Word attraction /doe\. for If they mean ~~by it, that things~~ /In generall\
~~onely some~~ /all coming\ together, ~~another~~ /the\ word, ~~as~~ approach, w[^ch^?]
hath Not a p^r^judicate sence, is /more\ proper; ~~y^e^ other is an~~
~~Illusion againe~~, If they Mean ~~all coming's together~~ /~~to be~~\
~~by Attraction, thats~~ /~~were~~\ ~~comes to nothing, y^e^ Word Motion is~~
~~more proper & significant. If~~ onely Some thing's, then
It ought to be Explained /as may distinguish, & either way\ ~~w^eh^ and how~~, /~~otherwise~~\
~~And after all~~
y^e^ Word /Attraction as they use it for Coming together\ is Insensible, and amounts to
No More
then coming together, by Coming together; Such
mischeifs happen when Naturalist's affect words, &
doe Not Explaine them.

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[44] '*vires*' is the plural of '*vis*', so: 'forces', or 'powers'.

Geometry.[45] phisicks ~~9.~~

I mentioned artificers, who Should take the Refined
Materiall from y^e^ hands of y^e^ Naturalist, and shape it
ffor use. those are Geometers & Mechanicks. I know
well how Much Geometry is p^r^ferred above all other
sciences, and particularly this of Naturall things;
And ~~it is~~ all /is\ founded on the certeinty of the princi=
ples, and wonderfull scope of reason, & Invention
Exercised by it; All w^ch^ I allow, and cannot but
Recommend y^e^ ~~practise~~ use of it, becaus Nothing doth
so Work the mind to a Method of discerning the
strength & weakness of allegation's, and make~~s~~ it
So ready & willing to Reject y^e^ Weak, as also /to be\ tena=
cious of the strong, ~~So Much~~ as that study /doth\. But when
y^e^ subject matter is In question, and the dignity of it,
I must p^r^ferr phisicall knowledg, as prior & superior,
to Geometry. ffor the very principles of Geometry, are
phisicall truths; such as longum latum & profundum.
And the ~~Natures~~ /compositions\ of all things; ~~Whereof~~ /ffor tho ~~w^eh^~~\ Geometry ~~is but~~ /
~~doth not~~\
/~~penetrate~~\ ~~an art~~ /may\ weigh & measure /but not otherwise penetrate\. All the
knowledg is phi=
sicall, ~~ffor a~~ /And y^e^\ Geometer discover's Nothing, ~~that is Not~~ /beyond\
y^e^ Consequence of More, & less. It is No News, that Every
block contein's all the subject of Geometry, y^t^ is all
possible rations & propositions; and It is the same thing
If the place of y^e^ block be filled with Gold, wood or
stone. It is art Enough to shew those ration's, but
It is more worthy to shew the nature /&? value\ of the thing
~~that conteins them~~ of w^ch^ they are but the account,

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[45] The word 'Geometry' is both a supplementary heading, and a marginalium. RN here continues his account of 'phisicks' as a *paragone,* or contest of the disciplines, specifically between 'naturall philosofy' and Geometry.

10 phisicks.

It is Necessary here to shew that this Idolizing of Ge=
ometry[46] hath proved pʳjudiciall to other ~~arts~~ /sciences\, and that
a litle /to\ that here treated. ffor Men Not Considering
the different aubjects, and being In love with yᵉ Solemne forme /of demonstration\
/in?\ or yᵉ /Heroick\ undertaking's of yᵉ professor's, will be satisfyed
with Nothing that is not called demonstration. And
accordingly, ~~Ins~~ /In Naturall Science, It is No wonder\ Wee are Incumberred ~~with~~
rather
then aided with it; and ~~it were better~~ /one would chose that\ the Methods
of Geometry ~~wh~~ were wholly lay'd aside then used
In any process that doth Not wholly depend on Mea=
sure. ~~Cartes~~ /~~one grea~~\ Cartesius was yᵉ first yᵗ ~~broached this~~ /broached this heresie\
pʳtending /his\ phisicks capable of as clear Reason's as
Geometry itself, that is necessary consequences clearly
& distinctly perceived.[47] /And\ Since ~~that~~ /him\ others pʳtending to
Nothing level with him, Have Endevoured to Set up
Mathematicall principles of Natural philosofy,
wᶜʰ at yᵉ Entrance is fals; ffor the Mathematicks
must have phisicall principles, Not e contra.[48]
wᶜʰ to make plaine /observe that\ the mathematicks deal onely
In comparison's of Quantity, and /as I sayd\ determine of No=
thing but More ~~and~~ less, or Equall; let any one Judg
then, If the caus of raine or Snow can be drawne
from such principles and method of argumentation.
I Grant they may Compare /forces, as for Instance ~~that~~ In staticks that of\ Gravity's,
but Not Say
What is ~~the caus of~~ Gravity /but assume that from yᵉ Naturalist\ and /so they may\
determine the E=
vent's of motion, upon fitt data, but Not Satisfie us
of the nature & theory of Motion; ~~from~~ /wᶜʰ belongs to naturall philosofy\ whence they
must take those certeinty's on wᶜʰ they found their process.

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[46] *See* note on f. 109r.

[47] According to Descartes (in the Third and Fourth *Meditations*) we intuitively recognise the truth of an idea if it is percieved as 'clear and distinct' (*'clare et distincte'*). These words echo and return throughout the MSS.

[48] i.e., 'the other way round, on the contrary'.

But Now to Shew how out of plausible under takings
as this of Mathematicall philosofy, the clean con=
trary of y^e^ designe will succeed. The Author of the prin=
cipia, hath forc't himself to build up a systeme
of powers, to serve In y^e^ Quality of data, In order to
a mathematicall demonstration of y^e^ Mundane Sys=
teme, ~~that are all~~ /of w^ch^ More are\ so p^r^carious, or rather fals, ~~as~~ /that even\ the
old orbs of ptolomy[49] Might as ~~well~~ /justly\ be ~~chosen~~ /Relyd on\ as that.
~~As for~~ /To\ Instance, ~~that~~ /He assumes that\ all body's attract Each other
ad mensuram densitatis, then that there is a vis
centripeta, and another centrifuga; and Rare=
faction is the vis partium ~~see~~ sese Mutua fugien=
tium, and Condensation, attrahensium; & y^e^ like.[50]
All w^ch^ wee would have allowed, had it bin Inten=
ded a fictitious model to Exercise a Geometrick
talent upon. for then Nothing were to be Noted but
whither his conclusion's were truely drawne, accor=
ding to his principles, without being Concerned whither
they were true or fals. But that author, conscious that
that his vires might (& with good Caus) be all denyed,
or at least, Not Granted; caution's us at first /to take Notice\ that
he assumes them Not, as phisicall principles, but as
Stated forces w^ch^ at that time, & for his porpose, he
makes use of. But then In Conclusion he comes to
affirme & determine of the whole state of Nature
as if his principles were admitted phisically true.

---

[49] Ptolomy (90-168 CE) described a 'mundane systeme' where the stars, planets and sun encircled the Earth (at the centre) on crystalline spheres. This model was inherited from an ancient tradition.

[50] i.e., that bodies attract according to their density; that there are centripetal and centrifugal forces - the one the force of rarefaction (force of mutual parting) and the other (centipetal force) of attraction. These are, oc course, Newtonian terms.

That is, in a word, he declines to veryfie his principles
upon ~~naturall truth~~ Nature, ~~and~~ /but\ Concludes the whole
state of Nature from his principles, and this his /phisico-\Mathe=
matico way of proceeding; But before wee part to
doe him right, he hath taken Exquisite paines, to
shew the phenomena of y^e^ planets, answer his supposed
vires attractiva^e^. c. w^ch^ wee may admitt, and yet Not
Grant them true. ffor aptitude is No argument /of truth in\ ~~y^t^~~
an hypothesis is true /tho Ineptitude may Convince as\; the Tolomaick systeme[51] was
once thought to agree with y^e^ phenomena, & accordingly
though /Received as\ true; but latter witts & discovery's have /everted\ ~~a=~~
~~bolish't~~ it; who knows what detection's may be of
~~this fabrick~~ Infirmity's In this fabrick of y^e^ vires? ~~so at p^r^sent~~
~~wee leav it to its fate~~.

But wee must allow that having setled a founda=
tion ffor a Cours of Naturall knowledg, w^ch^ all must
agree, is built upon Quantity, ffor Not onely body, but
Spaces, or distance, /motion\ number /&\ time, all are Extended
and, to our sence, consist wholly in more & less, w^ch^
comparative taking place in Most, If Not all actions &
alteration's In y^e^ world, If once wee gaine stated terme[s?]
of thing's opposing or cooperating as causes, whereof
y^e^ Effects must be Corrispondent; the Mathematick
process, will be of very great use, & discover truth's
as to Exactness, w^ch^ experiments cannot. But that
is a talent peculiar to Some, to Whome wee Shall
leave difficult calculation's, and deal onely In y^e^ Reasons

[51] See note on BL Add MS 32546, f. 106r.

phisicks. 1.[52]

~~Now allowing this account~~ /having sayd thus much\ of science, /In general\ I shall Not
Enumerate All those, w^ch^ by particular apply=
cation to certein subject's have obteined Names,
~~as ordinarily is~~ /commonly\ knowne ~~by the~~ /among\ professors of sciences,
But apply my self cheifly to that w^ch^ distinguisheth
between the ~~reallity's~~ /truth\ of thing's perceived, and the
Image or ~~Idea In y^e^ sence~~ /sensation\ by /means of\ w^ch^ they are knowne,
And this the Greeks called phisica, & /~~in~~\ ~~our language
is ordinarily called~~ /wee\ Natural philosophy, And May
be devided Into the science of /1\ thing's, and. 2 of y^e^
modes of them. The latter is better knowne by
the Names of y^e^ Mathematick sciences, w^ch^ are but
a secondary branch of phisicks, and Not pryor
or leading to it. ffor The Idea of Quality or Ex=
tension, is first Establish't In phisicks, and then
delivered over to Geometry, to Establish calcu=
lates and account's by w^ch^ on occasion, one
Quantity may be compared with another,
And when this is done by continuall addition
or substraction of y^e^ same thing, w^ch^ they Call
one or [an?], unite, or breaking it Into parts
(w^ch^ amounts to y^e^ same) It is called arith=
metick; So when phisick's have setled ~~that~~ /y^e^ rules\
~~motion's~~ of Movements, the mathematitians
proceed to calculate them, as when weight
is declared to have Effect as a Comon
velocity, In ~~the same~~ /divers\ Quantity's, then the

[52] This is another beginning, again numbered by RN; it continues to f. 22v.

statick art takes it, and from them the skill
of beam & scales proceeds. And these Come
round, ffor the naturalists have aid againe
of ye mathematick rules, ffor making disco=
very's of divers thing's, wch they had No other
[meas?] to come at. As the Explanation &
skill of Machines: wch however grounded
on phisicall principles, yet by reason of ye
composition & members, it is Not obvious
or rather very difficult, to find out, how
those principles work; the mathematitians
analise ye parts & shew them ~~from one to~~ /Each ~~apart~~\
~~another~~ /asunder and\ how /thereby it proves\ ~~it is so brought about,~~ that
a less thing, or weaker, shall prvaile agt
a greater and stronger, ~~otherwise almost~~ /(a seeming\
~~a~~ miracle in nature), And ~~there~~ so ye
Naturalist is lett in to ye knowledg of
the Effect's of his first principles, by ye aid
of ~~that sort of~~ /ye\ Mechanick Science.
It is No part of my designe to shew /wth\ what won=
derfull art and Exactness the Geometritians
will drive these comparison's of Quantity's, and
so discover the mean's Exactly of finding ye
Ration's between them. those yt are verst in
those methods they call synthetick, ~~weh goes from~~ /& analitick of ye former\
/works [by?] stepps from\ principles, or data, to propositions & theorems,
& ye Other's back from them, Into ye principles & is
called Algebra, both being but artfull Methods of
accounting

accounting & Comparing various Item's of more &
less, & thereby gaine Equalitys

But with due Respect to y^e^ Exellency's of y^e^
Geometrick Arts, I affirme No knowledge of things
is from them but from Naturall Inquirys or Phisicks.
ffor the Geometers have their data, w^ch^ May be
reall or Imaginary, ~~It is~~ all is one, their conclusions
are true, but phisick's Must Not onely have data
but p^r^cognita, such as really Exist, & fall under
the Notice of our sences, however y^e^ Manner is,
And for that reason, the phisicall principles must
be knowne certeinly, or so violently probable, as
with Comon honest Wee cannot decline to admitt.
And then the process is Not Comparing y^e^ principles
one with another, as the /sensitive\ appearances of them ~~In~~
~~Ju~~ with the thing's themselves; and Judging, what
Resides In the object, and what In y^e^ Imagination
becaus it is found that much variety is perceived
by sence, w^ch^ No object hath or Can have. as
the Image of Colours, sound of Harmony & the
w^ch^ are ~~as~~ /but\ strokes upon y^e^ organ; As strokes with
a battoon, gives a paine, If on y^e^ head of one
sort, If on y^e^ back another, & so divers other -
paines as it is applyed, w^ch^ are but various sen=
sation's occasioned by the stroke, w^ch^ wee may
give Names to as to sounds & colours If wee
will

4. phisicks

Will, but None can say any of those paines or
ought like ye Image wee have In our fantasys
upon ye Stroke, Resides In ye batoon, but It is all
mere creature of Sence; and abstracting all
sensitive being's from ye World, Neither pain
pleasure, light colour, musick, sounds or
any fantasme's of ye mind however ye causes
may still subsist, will Remain & have any
essence at all.

And for this reason ~~phis~~ ye Naturalist, Must be
armed, with a copious history of observations
of his owne, and others; to have matter to work
upon; All wch is true knowledg wch Geometry
doth Not prtend too. And for like reason's, I accoun[t?]
phisicks ye Nobler study, and more Inriching to
the mind; ~~for It prpares~~ /and armes\ it agt ~~Receiving~~ Im=
posture. And So Excellent it is ffor that porpos
that ~~a comon~~ /no\ person ~~of his owne~~ /is secure from\ furberies
& cheat's, who hath Not made a sufficient
collection of differences between things and [their?]
appearances, and with a competency of them
he is safe, and Not Exposed as some of poorer
minds are to the senceless fables of ~~wicheraft~~ /witch-land\
and faiery kingdomes; for with what should
they confute them; whereas ye Naturalist is
Ensconced in all safety, by his acquired
knowledg. so Much I thought to Say of the
nature and dignity of phisicall studys.

phisicks, ~~11.~~

Another Enimy is that In forrein part's is called holy
church, but means a politiq hierarchy of Ecclesiasticks
whose Godliness is Gaine, and have y^e^ possession of
deceiving y^e^ Rest of Mankind, with their principled philo=
sofy and pia^e^ frauds[53]; a Right principled philo=
Sofy is Not for y^e^ service of these, ffor by it men are
taught Not to be too credulous, to examine and
both clearly and distinctly to Conceiv y^e^ Subject
matter before they subscribe to it. They are putters
of hard Question's, stirrers up of doubdts, that is all
diametrically opposite to a trade founded upon
meer humane, & p^r^carious Authority. And for this
Reason, that w^ch^ is Called New philosofy, a knowledg
brough Into y^e^ world, by a set of cotemporary Heros
~~In~~ well enough knowne, for w^ch^ they deserve diamond
Statues, is litle less then abolish't in forrein scools,
Except where some Reformists are, who allow greater
freedome, Not thincking fitt as y^e^ others, whatever their
opinion is, to make /free\ philosofy punishable, as /damnable\ heresie.

I cannot Say it is So in England, ffor freedome of
philosofizing, If any where, Reignes here. yet one may
perceiv a yerning of a sort of grave men ag^t^ it, as
If the New philosofy, or what is Called Cartesian, Cor=
rupted men's manner's, If not their Religion, Inclining
them to Atheisme; and I beleev most of them are In Ear=
nest, However I thinck better, and ascribe Atheisme
to y^e^ [paucity?] of christian witnesses, then to any philo=
sofy

[53] i.e., pious frauds (also/usually *'pia fraus'*).

phisicks

-Sofy; ffor Religion is founded on testimony more
then argument, /otherwise then in affirmance of y^{t} testimony\ y^{e} Gospel & faith being
of things
seen & heard as well as unseen & beleeved; wherefore
y^{e} Apostles, ~~and~~ primitive Saints and fathers of y^{e}
Church, confirmed their faith with ~~their blood~~ /suffering & death\, and
Not ~~by~~ /adorned with\ p^{r}eminences & p^{r}ferments; otherwise, huma=
nely speaking, litle ground had bin got, for who
would beleev men y^{t} preached for their owne gran=
dure & authority? as pardoners, to sell their Indul=
gences; therefore I consider it is corruption of Authori=
ty, w^{ch}, perhaps, cares not a freedome of thincking
should p^{r}vaile, and Not this or that philosofy, while
y^{e} people In generall, are neither capable of Nor
concerne themselves with any, that hurts Religion.
I will say this for y^{e} new philosofy assuredly, that
Even y^{e} methods of that have Enabled our clergy
In controversie ag^{t} Romanist's & sectary's, and
Rendered them so Much superior; for they dispute,
and for Instance In particular ag^{t} transubstantia=
tion, In y^{e} very termes, & language of y^{e} Cartesian phi=
losofy. and therefore one would thinck they should
not so Continually flirt at it, as they doe.

Another Enimy philosofy hath, & ever had, and y^{t}
is ambition. It is a strang penchant men have to be
famed philosofers, and to be set up & Read In
acadamy's, as onely authentick, while all other
species of philosofy Must truckle & submitt. they
say old Aristotle, took this Cours. he lived In an
age

age of disputing, and had y^e^ hon^r^ to forme it into
an art, whence our Comon logick is taken. before
him In divers ages were a sort of Reasonable
Naturalist's, who had Come to their Ne plus,[54] &
so philosofy Stood at a sort of stay, waving a litle
from ~~y~~^e^ one sort to another. And Aristotle served all
all alike allowed or Comended None, blamed all,
used Not one dogma of y^e^ ancients, but made an
Intire New Model of his owne, not calculated In y^e^
least for Invention or assertion of truth, but onely
to supply answers to all Questions, and such, as Whi=
ther true or fals, Could Not be ~~disputed or~~ Confuted.
And therefore Moulded his work In termes & distinc=
tion's, more like a logick then naturall philosofy,
a meer structure of words. And however this took in
his owne time, it is certein upon y^e^ Revivall of lear=
ning it Came with such authority from y^e^ Arabs,
that it was Received, as the Gospel of y^e^ Scools. and
altho Plato was In possession, this displac't him, as
more accomodated, to the trade of disputing then
set on foot, w^ch^ clouded y^e^ literate world, till y^e^
hero's I mentioned caused it to clear up. Here
was a ~~su~~willfull suppression of true philosofy, with
no litle art & very Much ambition.

It is well knowne that upon the late Restaura=
tion of philosofy by cartesius, I mean his Method
and principles. the vertuosi have professed a
most

[54] i.e., 'no further', a limit.

14. phisicks

~~at~~ Most chast & sanctimonious persuit of truth, Car=
rying y^e^ Caus so farr from authority, that Nullius
In verba, was y^e^ Word.[55] this was y^e^ other Extreme, but it
took and a Colledg founded, on a plan, ffor Ma=
king a Collection of Experiments, & out of them [~~...~~?] /compleat\
Hypothesis /of nature\; that is to vex nature in Secula secu=
lorum,[56] If it continue till that designe is Compas't.
ffor I observe that Comon occurances carefully and Skil[l=?]
fully observed, /have\ given greater light In philosofy, then /y^e^ Mor[e]\
vexed Experiments have done. And Men Cannot live
without Experimenting a great deal, and No Mean's
can be found out, as I more then fear, to give us An
Insight Into y^e^ minute texture of Compound body's
and y^e^ Shape's of their Component parts, without
w^ch^, I profess, litle will be gained by vexatious Exp=
riments; But yet /An\ Enterteinem^t^ that way /is\ both plea[=?]
seth, and gives mean's of observing what otherwise
would pass without Notice, and If Expectation is Not
answered In events one way, some may be very
Extraordinary & Surprising In another. As wee find by
M^r^ Boyle, who Confuted most demonstrable, all
Hypotheses and principles of Naturall philosofy
Except y^e^ Corpuscular.

An Enimy of this order I take to be y^e^ late Introduction
of Quality's and property's for principles. as vis cen[=?]
trifuga, centripeda, attractionis, aversionis, Inertia
& y^e^ like. And Introduced with Great Modesty decla[=?]
ring them as onely data for Geometrick practis

&

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[55] '*Nullius in verba*' (i.e., 'take no one's word for it') was the motto of the Royal Society.

[56] i.e., 'for a century of centuries' - i.e., for a very long time.

phisicks ~~15.~~

And [Restraing?] our forewardness, least wee Should
p^r^cipitately Mistake him, as If he Intended these
for phisicall principles. all w^ch^ had bin admirable
If he had made onely mathematick Conclusions
but so far from that he bends All his forces, and
Concludes as fiercely against the corpuscular hy=
pothesis, & the Cartesian solution of the ~~heavens~~ /planetary\
Courses, setting up vacuum, and then filling it with
light & powers over and over againe; as If his de=
signe had bin phisicall from y^e^ beginning. It seems
y^e^ author was Educated In y^e^ time of Cartesius works
first appearing In y^e^ university, and then bent
all his studys & endeavours to Confute him. that
hath bin the very stress of his Soul, therefore wee are
Not to wonder, he Relapses Into that fatall Error
of setting up Quality's, w^ch^ Cartesius & others had
So [devinely?] Excluded. How many Ingredients of y^e^
foregoing Emnity's have Concurred in y^e^ [brassing?]
this author I will not determine, for I Revere
him for his Geometry In w^ch^ he seems adept. but
as for philosofy, the Geometer hath crusht it, or
he would [Crush?] it, ffor If his Notion's stand, phi=
losofy will Never rise, such is y^e^ Weight of /his\ Qua=
lity's, to say Nothing of his Contradictions.

An other & y^e^ last Enimy of philosofy I shall speak
of, is pride. some would have all knowledg to them=
selves, & let other's have No share; And so become

more

~~As Mou~~ more admired, as Mountebanks are for
shewing tricks others doe Not understand, these
are but a sorry party And may be past by onely
with y^e^ Respect of having bin mentioned. as for the
Ignorant & p^r^judict /Enemy's also\. I shall bestow y^e^ whole world
on y^e^ former, and dedicate a chapter to y^e^ latter
w^ch^ may I hope suffice for both.

phisicks. ~~1~~.

The sumé of Naturall philosofy, is to distinguish
well between sensation's of things, and thing's them=
selves. ffor It so happens, that the truth of thing's doth
not appear ~~by~~ /in\ y^e^ Sensible Image of them, and ~~then~~ the
Sensible image is very different from, ~~& seldome or Never~~
~~comprised in~~ the thing /it self;\ Examples best shew this, and
a few may serve among Infinite others y^t^ are obvious.
No one can discerne Gold by y^e^ Colour, for Guilt Wood
hath the same Image. but a naturalist weigh's it,
and by that discovers wood, from Gold. ~~Then wee have~~ /so\
Images of sound, ~~& under that y^e^ differences of~~ /~~of them~~ particularly\ har=
mony and discord, ~~also~~ /as also of\ light & ~~various~~ Colours; ~~and~~
~~to these variety's wee~~ /w^ch^\ for distinction & comunication
Give names, as fifth's. 3ds. &c. in sound; Red & blew
In Colour. but these /variety's of Images\ are In y^e^ sensation and Not in
the object /altho y^e^ occasion is from thence\. w^ch^ to Confirme, (for ~~it is~~ /y^e^ thing is
Now\ comonly agreed),
observe /when\ a stroke with a staff ~~gives one sort of~~ /causeth one sort of\ paine
~~and~~ /but\ with a Sword another. These paines are In the
sence, but Not In y^e^ Staff, nor sword that Caused
them. And It is the office of a Naturalist, to discerne
what share In this effect of making us sensible,
belong's to y^e^ object, and what is ascribable to the
sence wholly, & is Not in y^e^ Object.

Naturall skill is to know. 1. ~~What things are in~~ /Essences, as what things are\
~~themselves~~, and then. 2. the modes ~~of them~~. that
~~is Quantity~~, place, figure, time, & y^e^ like. The first
are ~~found out~~ /gathered, by ~~different~~ /various\ sensations of ~~the same~~ /divers things\
~~thing~~; /& comparison of them one with another,\ the latter ~~belong cheifly to y^e^~~
~~Geometers~~ /by various sensations\
of one & the same, ~~and the~~ And thence proceeds y^e^ art ~~and~~

phisicks

~~and theirs being y^e art~~ of measures, ~~are~~ /y^e same is\ a part of Natu=
rall skill, so farr as depends on measure. The way of
Examining thing's is 1. to obtein a Sence of them
and If possible y^e like, reiterated, severall way's; and
If such help is not to be had, then to Compare the
neerest likenesses wee can, and So Gaine some foun=
dation to make a judgm'^t upon. of this examples are,
1. of things too small for ordinary vision, then wee have
no mean's but Glasses of magnification, by w^ch wee
find numberless [animalenlis?] of w^ch there was No
thought before such were used. Then If thing's are
Neer lost by distance; wee use y^e Same helps, w^ch let
us in to a knowledg of y^e Mundane systeme with
evidence heretofore unknowne. of Comon objects
wee feel, tast, turne, heat, cool, burne, & torment
Severall way's, and comparing the severall appea=
rances of y^e Same materiall to our sence under
all these vexations, Wee collect somewhat of truth
concerning them /w^ch\ wee Could Not have otherwise
by any sence have found out. This searching and Can=
vasing thing's severall way's, is what they Call Experi=
ment; and is most necessary ffor a Naturalist to be Im=
ployed in, ffor sometimes, tho rarely, very great disco=
very's have bin gained accidentally by experimen=
tall practises; And of these I must allwais account the
cheif to be the late discovery of y^e air, and its proper=
tyes, by that Called y^e Torricellian;[57] W^ch hath opened to
us a new scene of knowledg, styled the Spring
& weight of y^e air.

[57] Evangelista Torricelli (1608–1647), Italian physicist and mathematician, student of Galileo, and inventor of the barometer.

~~phisicks~~ ~~3~~.

Therefore wee must observe that y^e^ Experiment &
Judgm^t^ thereon are two things; the former Collected
is Called Naturall History; w^ch^ is accounted of grea=
test Importance In y^e^ suit of knowledg. therefore some
would have that perfect before any proceeding is
had In y^e^ way of Judging. It must be admitted that
Naturall history Is Imperfect Enough, there being litle
one Can trust. the late work's of the Microscopi=
call Men, as M^r^. Hook, M^r^ Malpighius, & D^r^ Grew
are Most Considerable, and what scrapp's of Nature
doe they Inclose? The works of M^r^. Boyle, and y^e^
esperienze del cimento,[58] are very usefull, and Ex=
tend to Cases more generall. Now If Judgm^t^ must lye
fallow till y^e^ whole univers is perfectly surveyed, y^e^
science of phisicks must dropp.

Therefore I distinguish farther of Experiment, 1.
such as ~~is~~are Quotidian & familiar, as the comon
phenomena of /sence w^ch^ are\ Motion, light, sounds, order of the
planet's & the like, w^ch^ No one, y^t^ hath an observing
genius wants. and. 2. Nice Experiment's w^ch^ are
y^e^ profession of our Royall Society to Make & Register.
The former I take to be sufficient for Edifying a
naturall Skill, So farr as the generalls of that science
Require. that is the Matter of y^e^ World, & the Con=
dition of it, motion with y^e^ Rules; y^e^ Mundane
systeme, the reason of light, sounds heat Cold
& many other like topicks, w^ch^ condiscend Not
to

[58] *See* note BL Add MS 32546, f. 319r.

to Resolutions of particular matters, depending on Nice
composition and texture of parts. and as to those, our
ordinary sciences will goe No farther then, to Shew
~~that~~ 1. /possibility & 2.\ probabilitys all w^ch is argued from a parity
of Reason so far as wee may p^rtend to a knowledg
of principles. this is a lower order of knowledg then
The generalls, such as Gravity, light, sounds, &c ffor
those are knowne so much by universall & continuall
approbation, that litle is wanted that is reasonably
to be Expected of assistance In y^e Scrutiny of them.
and as ffor the particular solution's, curious experi=
ment's must Introduce ~~them~~, or at least Gaine Some
farther ground In the Scrutiny of them.

But I am altogether ag^t a Method used of old, &
now of late Introduced, w^ch is /to doe all, by Qualitys & otherwise\ Not to Inquire
Into
Efficient Causes; ~~but~~ /And Now they propose to\ ffirst Gather pha^enomena, and
the laws and property's of them, letting Efficient Causes
wholly alone. those were Aristoteles Quality's of old,
who supposed body's Endued with certein Motions
as appetites w^ch lead them. and the latter have as=
cribed attractive /and aversive\ forces to body's ~~and so aversive
& the like~~. and shew how attraction takes place in
y^e heaven's, by adapting all y^e planetary Courses,
& orbs, so as to make it seem their comon attraction
Influenced Each other; and the like upon y^e Earth,
as Gravity /& y^e sea\ tides, and In Sequel of this, make all
the complex phenomina of fluids, & y^e Continuity
of bodys, to be by an attractive power of a sort

proper

But It is Just to Add the disadvantages ~~of~~ these
Study's /have\ together with y^e^ Reason's why Geometry
is so much Exalted above them.

The Study of nature Is Incumbred with Extreams, vis^t^
of magnitude & Minuteness; ffor first y^e^ Grand Econo=
my of y^e^ world is So farr beyond our comprehension, &
our knowledg of it, from such Small hints from the or=
dinary celestiall luminary's; that however reason=
able ~~Judgm^ts^ may be made of the co~~ /Hypotheses is framed ~~from~~ for making\ the
~~alterations~~ /changes [they?]\
~~of~~ seem reasonable & consonant to the Cours of Inferior
thing's better knowne, It is Still In y^e^ power of the dis=
satifyed, to deny all y^t^ is affirmed of it, and No Regu=
lar demonstration's past Confutation can ~~be~~ be given
of them. Hence Eternall differences are & Ever will be
about the grand articles of y^e^ heavens, besides y^e^ Mo=
tion of y^e^ Earth &c. Now agreed, but whither y^e^ /Interplanetary\ Spaces
are plenum or vacuum; whither the planetts attract
one & other, & y^e^ like. So that y^e^ Indifferent by Standers
Who wait to see these folk agreed that they might
with countenance take their ~~words,~~ /[loyal parol?]\ or have demon=
stration of y^e^ Matter Goe away smiling rather then Sa=
tisfyed. And It is Not In y^e^ sphear of mortall braine to
propose any way to demonstrate such matters, But
Since there must be some Rel~~l~~Solution, If Not for Com=
on yet for private satisfaction, y^e^ caus must Not be
let fall but brought to a crisis upon some Measures
or other; and I thinck None better, then to have a
clear & full account of all occurences of movements
here amongst us, and from similarity with them. de=
termine

termine of y^e Grand systeme of y^e World, ffor since
no differences can be raised, where proportion's [agree?]
as will be shewed when I speak of magnitude.
let y^e Mundane systeme be by Imagination Con=
tracted Into y^e Compass of a Comon Globe, & abstrac=
ting all weight & terrene Incumbrances, with al=
lowances, for space in acc^o of time, & then set y^e Ma=
chine on worke, and Imagin If it be possible it Should
have other Rules & orders of movem'^t then belongs
to Sublunary bodies? I beleev there will be No reason to
assigne any, & then I thinck y^e Comon principles of
movements ~~will~~ /must\ serve /also\ to Regulate /In our minds\ y^e Motions of y^e planets
~~as guide~~ /Whereby also\ the straws & sticks in a whirlepool, ~~are~~
as wee see & know are [~~.~~?]regulated here below.

Another ~~great~~ Incumbrance of naturall know=
ledg, ffarr more weighty then y^e former, If Not
Insuperable, is minuteness. ffor it falls out that y^e
reall action's & formations of thing's w^ch occasion's
most of our Ideas of things amongst us, that
is y^e [~~Minute~~?] /shapes\ and motions of minute corpuscles, and
y^e texture of Compound body's, is so ffarr below us
In Exility, that wee have no mean's to gain y^e
least scrutiny of them; but all is absolutely In y^e
darke, & as to our Examination, as If all were bury=
ed ~~in~~ /as deep as\ y^e Earth's center. And here ly's y^e Incurable
defect of humane knowledg as to naturall
thing's; So as Nothing can be pronounced, [off?]
originall causes of ~~our~~ most Ideas, but by Meer Guess.

phisicks ~~7~~

And how Contemptible a process that is among
the literati, Especially of y^e^ Geometrick faction, is
No Secret. yet as Quintillian say's of oratory,
wee Must goe on, - Audendum tamen.[59] And ha=
ving a sphear of scrutiny, as I may Say, y^t^ is some
Gross matter to practise upon & observe, wee must
make y^e^ best of that, and In our Guessing Ever
observe to admitt nothing /among y^e^ least\ that is Not Consenant
to y^e^ rules y^t^ take place among y^e^ Greatest wee know,
And also Imploy y^e^ Imagination to translate the Effects
of a few examinable thing's one upon another
Into those miriads of miriads of part's or Corpuscles
w^ch^ compose the aggregate Quantity's, whither
fluid, or solid, that p^r^sent Nothing but Indistin=
ction & confusion to o^r^ Senses. And This one may In
Some Measure doe by a mentall [~~..~~?] Extension
of thing's, as let a Nutmegg /or any such known Compound\ be Supposed as larg
as y^e^ Globe of y^e^ Earth, then Imagin what Mountaines
valey's, cavernes, & unaccountable hollows & Inequ=
lity's, may be found In & about it; & so upon occa=
Sion of other thing's. this will be Sayd a poor
Shift, but If wee have No better, wee must Con=
tent our selves, and Ever be carefull of one thing
never to be Confident of Incerteinty's however
plausible.

[59] i.e., 'yet be bold'. *See* Quintilian *Institutione Oratoria*, Book 1, chapter 5, section 72; the phrase had been previously and famously used by Horace in Epistles I, 2.40. *See* also BL Add. MS 32546, f. 153r, and note 38 in the biography page on this website, at http://www.ucl.ac.uk/north/bio.

plausible, but allwais caracterise things after the
standard of Evidence, what is certein affirme it, so
What is less certein, allow it In termes accordingly,
and what is problematiq or Meer guess, be No Nig=
gard, but ~~withall~~ with No farther p^{r}tence then as
such; ~~&~~ weigh the probability's, & Represent them fairly,
leaving y^{e} Matter to Judgm'^{t}, Giving freely y^{e} owne.

This Introduceth another disadvantage this philosofy
fall's under, and that moves not from thing's, but from
person's. And generally is owing to overconfidence, and
Impotent assurance, not to say arrogance, & contempt
of others, whither accompanyed with a good under=
Standing or without it, Since both are found peccant
that way. I need goe No farther then Cartesius for the
first, who was y^{e} light of y^{e} latter ages, and So Sovereigne
a philosofer, as it would be fulsom to add In his prais.
yet he was unhappy In what he excelled, that is fran=
chis from p^{r}judice, ffor he was Not Cautious Enough to
Express his reason's for his fundamentall principles
so as to obviate Reply, but left himself open, so that
it is a pleasure y^{e} Novices take in objecting Contemp=
tuously to them. as his plenitude, vacuum, motion
&c. In w^{ch} I need Not Instance, so well is the subject
beaten. but when he comes to branch Into Item's
of less consequence, he Not onely Guesses, but Expres=
seth ~~th~~ too Much assurance; and the foundation's he

lays

phisicks ~~9~~

lay's In his disposition of y^e^ Mundane matters /for such occasions\ is very
p^r^carious. But much is to be Excused in him, being
litle less then an ~~Ient~~ Inventor of his philosofy, so
Repleat, after all, with admirable hints of truth, tho
the ungratefull academicks that use them, cannot
but Revile him. If so Much of him, What Shall I say
of the tail of the peripaticks, If any be left. or of the
Moderne chimists, that set up salt ~~for~~ sulfur, & I
know Not what for principles, w^ch^ Neither they nor
any Els can define what they are, nor of what Con=
sisting to distinguish them one from another, but Some
different Effect's, & opperation's, w^ch^ it is knowne flow In
like maner from various matter y^t^ Was Never set up
for principles; As North winds & south winds have
very different Effects, but are Not p^r^ferred to the state
& dignity of principles. but all this is Nothing to
M^r^ Mayo, who with y^e^ help of nitro-aerio-salino-
sulfurio, &c. particles, Resolves all Naturall doubdts
In a trice.[60] yet all ow these to pass as Ingenious, there
is a low sort of philosofers, who delight in words
and wonders, as one who told me A long story of
fossile-Cedar; with many Such Impertinences; These
are Ignorant of nothing, no demand can be
made, however Improper, as why Grass is Green, &
y^e^ like, but they have a jargon at hand to Resolve
it. W^ch^ Empty assurance, together with a pert beha=
viour, ceasless talking, & vaine boasting, Especially
about Invention's, then w^ch^ Nothing more raiseth civil

[60] *See* note at BL Add MS 32546, f. 100r. What follows this dismissal of the Paracelsians is RN's general assault on the lecturers and demonstrators who popularised the ideas of Newton. Further work will perhaps turn up some names, and identify some textual sources, for these characters who annoyed RN by knowing the answers to everything.

10. phisicks

~~civil~~ warr among y^e philosofers, makes y^e profession &
very Study they value themselves upon seem wretched
& ridiculous. It must be admitted y^e termes of art are
Necessary to be used In all sciences; but In Comunica=
ting with less or No artists, y^e fewer y^e better, becaus
to them such appear pedantiq; and Comon speech is
the best dress, If y^e Subject can be made underStood
under it; and when o^r vertuosi learne to Shew less
confidence, and Speak better English, they will be More
Respected.

These are Incumbrances or burdens w^ch ly heavy upon
y^e profession of Naturall knowledg, tending to depress it
But there are Enimy's also, and powerfull ones, and
such as have brought it downe, so as to be almost
layd aside, and If they have their will, there Shall be
No farther p^rtension to it, then enough to Satisfie y^e
Importune Questions of idle people by pushing their un=
derstandings. before I enumerate them, I must observ[e?]
they are all Cryers up of Geometry, as y^e onely Science
Worth Courting; and all by reason y^e data, are so
sure, that it is y^e artist's fault If he err; whereas in
phisicks say they, there is No firme footing. Now here
we differ; and deny that there is No firme footing, w^ee
say there is Some firme footing but Not Equally so, And
as it is In Geometry, all lean's upon one & y^e Same foot
and If some matter's treated by philosofers, lean
onely on Conjecture, that doth Not depreciate the
Rest, w^ch are better Grounded, & Some as sure as Geo: it self

31r[61]

phisicks.

It is some confirmation that union comes by flatt
contact, that all salts w^ch^ shoot in plan-sided
figures, are Made up of plan-sided parts, w^ch^ fall
aptly together, & from the shape of the components
the compound is figured. This is conjecture, tis true,
but such as Nothing of Sence will dispute. and there
is Never any shooting of flux't salts in orbicular,
but all in plan-sided shapes. And wee find No Caus
or cement, but their apt shapes, to bind them.

It is Consequent from hence, that wee Esteem Not
body to be adamantine, but however solid & com
pound, as If a Cubick foot had No pore, but were
Made up of onely Cubick part's so put together,
the rules cum data potentia, datum pondus.[62] If
the Globe of Earth In Motion prest such a body ag^t^
a suficient fulcrum, It Must crush y^e^ very Substance
& make it break out Every way. Since wee See
y^e^ whole world and all thing's In it Given to per=
petuall changes, It is Not probable y^e^ Elements them
selves are unalterable. Nor is there any Colour from
Experm^t^ to prove such Insecable, or adaman=
tine Nature of body.

<red BM stamp>

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[61] Change in paper size.

[62] i.e., RN *means*: 'the greatest possible weight with the least effort', this is a slight misquoting of Archimedes' '*Datum pondus cum data potentia*'.

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Of Continuity.

We Never had from any ~~Elimo~~/phisi-\logist a tollera=
ble acc^{o} of Continuity of body's, as It is opposed to
fluidity, untill D. Cartes brought forth that of
pure contact; I happen's that his acc^{o} is Not accep=
ted, but /by late Naturalists\ as gratis dictum[63] layd aside. ffor say wee,
No Experiment proves it. & then he Ought to shew it
to be a property of body to cohere, w^{ch} is Not done.
Le Clerck /use of\ the the latter phisiologist's, hath a short
process, concluding it a vanity to Inquire after y^{e}
caus of cohesion, as a thing that fly's from uS, and let
us Goe on, wee find o^{r} Selves In y^{e} Same state, as to
any discovery, ~~then~~ as at first. for If a Wisp is Made
of Many, Straw's, those straws of Many fibres, & so on
ad Infinitum. If wee say that body's are held together
by hook's and crooks of y^{e} part's, the Question Returnes,
what holds together the part's of those hooks? the
atomists suppose the Materiall parts to be /unporous &\ of all
formes, as hamous, Glabrous, rounds, square, &c, and
Say that, those that have part's Interfering, Co=
here by Such hooking. but they are answered that then
body's once claSp't together, Could by No force be par=
ted. for If they break, What force, and if ~~Every~~ /any\,
Why Not ~~any~~ /Every\? So that without assigning a Measure
of the force, with w^{ch} y^{e} hook's hold without breaking
It May be [either?] y^{e} least, & then cohesion y^{t} yeilds to
Every

[63] i.e., something said under no compulsion, and (usually to be) passed over as not meriting attention; in legal latin, it is a term meaning a statement freely given, and/or an unproven statement - all these senses are available when RN uses the term.

phisicks

Every force is Quasi None or ~~Inexpugnable~~ /Els absolute & Insuperable\, & then
No force will p^r^vaile Neither of w^ch^ is true. therefore
unless Cartesius solution help, le clerck is in the
right in Concluding y^e^ Question allwais Returnes, but
much in y^e^ wrong, to Say, becaus he cannot see any
hopes of discovery No person's should loos time in
Searching.

I must Needs Say, that D. Cartes rest's In the ultimat[e]
Effort of humane capacity to Examine; ffor after all
the thincking wee can bestow, wee Shall find out No
Ingredient of Cohesion but Contact. and It doth
Not deserve the Magisteriall Insults, o^r^ academicks
have bestowed on him, and it. I would ask all their
tutor-ships what is it that /(speaking of body)\ denominates one and
the same, ~~speaking of the body~~, but, that all the parts
are perpetually Contiguous. ffor If /several\ body/s\ clasp by rea=
son of their forme /I Grant\ their figures & superficies are yet
distinct and divers. but If upon putting two together
/by apt sides\ there is as Exquisite Contact In y^e^ juncture, /~~yet~~\ as y^e^ parts
of Either /alone\ have, then both /Joyned\ are become as Much one,
as with justice Either of them /apart\ Could be accounted. I
know that such contact's as this fall Not in our prac[=]
tis [.?] nor can any way be Experimented. but ~~If ther~~
they are Not Inconsistent in Nature, and May justly
be supposed, vis^t^, that 2. Cubick parts touch by aside
of each other Exquisitely. and then I say those two are be=
come one. and there is as Much reason to argue a
parting In any other place of either, as upon that
Juncture, ~~If an adventitious force ffall to occasi~~on it.

phisicks. ~~11~~

Then I conclude that If body's touch Exquisitely by
superficies, there is No difference or Infirmity In the Jun=
cture, then among the other parts but all cohere upon
the [Same?] principle contact. [~~That~~?] /but Its fitt\ to ans^{r} the sequel
of Inquiry's. 1. Why should any Contact unite? 2.
with what strength? for Some body's part Easily, others
with Great difficulty.

In order to ans^{r}. both these, I must Not Stick to
Introduce an hypothesis or principle, w^{ch} May be
assumed, but cannot /well\ be proved. vis^{t}. that Cohesion
or rather Coalition, or unity, is Incident to body as
Extension is. So as all body's that Rest /with\ Contiguous /sides\
are united, and from thence foreward become frangi=
ble Indifferently in all part's alike, and /accordingly\ yeild to y^{e}
Exigence of force however it falls. /~~yet~~ [~~... ....~~?]\ I may /Nevertheless\ alledg tow=
ards /a\ proof ~~of this~~ /of this hypothesis\; that /in reality\ body's doe Cohere, and
y^{e} Witt
of Man hath Not yet found any other Ingredient
or Means of it, but contact Continuing. w^{ch} is all I Can
say to y^{e} first point.

As to y^{e} other, with What Strength? I answer with a
Strength Equall to y^{e} substance. ffor so all the Strength
of body is accounted, & is Called the force of rest,
vis Inertia: It is No more possible to give a standard
of this force, otherwise then by Comparison, then it is
give a standard of Magnitude /or time\. ffor Every thing is litle
or great /long or short\, according as you Collate it with other things.
So this force of Rest, w^{ch} Makes a body less Mobile
makes it also less alterable, that is devisible. but as
No body but may be Moved, So also It May be broken

but

phisicks.

But Every force will Not break Every body, ffor all the
part's touching give way, & so y^e^ force falls not in such
manner as tends to devide; and If it doth, as supposing
a body held in a vice, & another to fall on y^e^ prominent
parts, If Greater then that, why should Not the less give
way, but If less, why Should Not y^e^ Greater continue
as it was. So that I must Conclude No substance or
cohesion of body, to be Inexpugnable, but a Suffi=
cient force, that is Greater body's aptly coming on them
Shall crush them. but In Regard Comon force, tends Not
to break In peices, but to drive on, breaking is Not
so Comon, as would be If thing's were handled With
art. but yet wee see Nothing Resists Imens forces &
Small ones doe Not ~~much~~ as to Crushing & breaking, /performe which\
so that the comon cohesion of compound bodys, serves
against ordinary, but Not ag^t^ Extraordinary force.

Yet the thing carry's a difficulty to be apprehen=
ded or admitted, ffor when wee suspend a vast
weight by a small wire, w^ch^ will bear a great deal
It is Strang So Small Substance Should hold ag^t^ So great
force; and all I can say to it is, first In generall that
wee have No Standard of the strength of body. that is
how much, in any stated Quantity, compared with
any other stated Quantity, ~~by~~ /supposed\ Moving In a way to
discerp it. Stated it is, and it is Increast and deminisht
with substance. compare it with duration, It is hard to
say how long an abstract hour is. but it is clear
to be 1/24 of y^e^ Sun's diurnall Circle. So I cannot Say
what the strength of abstract body is; but Such &
such thing's will break, with Such & Such forces.

phisicks.

Next In particular, altho No circumstance but
Quantity can augment. Yet there are Modes, w^ch^ May
deminish y^e^ power of Cohesion. as when the Contact
Is by a point, then I affirme there is No cohesion at =
all. So it is when Globes, touch planes or Globes, for
with them there is No Cohesion, for an hold by a point
is No hold, and for this reason I conclude that fluids
are Mixt of Globular, or plane-sided Mixt with
Globular parts. the latter May be y^e^ Case of Salts
w^ch^ by the shooting Into such Shapes, may justly be
Supposed to be built /up\ with such, & Easily Mix with
the Globular; under Globular I Include all figures
Inclining as long ovalls &c. ffor I account there are
No Exact Shapes /of bodys small or great\ ordinarily; but /when [thuss?] they are\
various & contin=
gent as Sensible body's are; And Globular Easily
compose with their like: And whither these Globular
& plane-sided are originall, or compounds, ~~Maters Not,~~
or whither they are formed & capable of flexure, as
straws cords, silk, &c. Matters Not. ffor wee shall Not
be Ever able to determine Either way, but /be that as it will\ our
Consequence is y^e^ Same,

Then as wee May suppose Matter in its Composition
to have Irregular Elem^ts^, as parts (simple or Compounds)
~~w^eh^~~ w^ch^ are more ragged, ~~&~~ /[or?] otherwise more\ aptly figured for Conjunct=
-ion, So they cohere More; and If ~~possible~~ /supposed\ to consist of
cubes ordinarily plac't, /then\ Most of all; of w^ch^ sort Juells
may possibly be. other's as gumms, coagulates, wax
& y^e^ like, touching between points & superfices are
easily flux, & broken.

phisicks.

The last discours on this head shall be of the Ex=
perim^{ts} w^{ch} look towards this theory, for direct wee
have None, and of them the cheif is. of flat Marbles
w^{ch} /being parted face from [face?]\ without doubdt /seem to\ cohere Much; but are
Easily
Moved laterally, tho with difficulty In paralellisme.
It is found that this Cohesion is Not from Contact
but from the weight of the atmosphere; because all
Experim^{ts} as y^{e} air pump &c. w^{ch} disable that
let loos y^{e} marbles. However Wee May from hence
fancy some addition to the Strength of Cohesion
If y^{e} separation be forc't In paralellisme, from the
plenitude of y^{e} world; and the want of apt Matter
figurated /or [...?] so as\ to Enter ~~angular sp~~ the space made by
a divulsion of one part from another. Especially in
this Instance. vis^{t}. Suppose A. & B. to touch by y^{e} flatt
<diagram> c.d. and a force applyed to both tending
to separate them paralell-wise however
small & apt y^{e} Matter is to Enter upon y^{e}
separation, It cannot be at d. & at. e. or at. c.
&. at e. In the same Instant of time. So that as In y^{e}
Case of the atmosphere, the draught is Not onely of
the two body's, but ag^{t} all y^{e} Matter in y^{e} World, or at
least so Much as Must be crouded together to Make
way that the minute Matter May Enter from c. &
d. to. e. w^{ch} at the first separation is or May be Imens.
and If the tendency of y^{e} force be laterall, to Move
A. from d. to c. and B. from c. to d. y^{e} Separation
may be with Much less difficulty.[64]

[64] In the lower LH corner of the page the word '[sults.?]'.

phisicks.

[Starting at top RHS marg: Its Inquired, what is body &
What is space, Suposing body
y^t is extruded, & space y^t is Exten=
ded, to be distinct and they are at
a full stand for both, ffor none
can say any thing of one or other but
If wee consult y^e nature of Space
alone wee shall find this that
that It be incapable of penetration, ffor that
one space should Croud into another when it is supposed extended by it self as
a contradiction, therefore I thinck the being of space [suplies?] Impenetrability,
[Starting at top LHS marg: then according to Cartesius, Space
& body is y^e Same, and wee are deli=
vered Both of the senceless consequen=
ces of Nothing being something as
attends y^e Comon
notion of vacuity.
and also of it is an incident Inseparable
that Con=
cerning. y^e
Intrinsick
Nature of
body w^ch
all allow
Impenetra=
ble and yet
suspect Some w^t
Els, but know
not What.][65]

The Nature of body & space

I am So Much with Cartesius, to thinck the Great art
of an almighty Creator is lowdly spoke in one Grand
~~Instance~~ /act\, or fiat, let there be space or extension, out
of w^ch that other ordinance of beings, called Souls or
Minds, have the food of such Infinite beauty & variety
afforded, as Each thinking person knows. Space abstrac=
tly taken (to give way to our fancy or p^rjudice) & /In language\ some=
what, but /supposed word of\ ~~unfilled with~~ body, /and so like as one may [surely?]
conclude\ ~~sure is Next to~~ Nothing.
~~In so Much that~~ it was No /fond~~ness~~\ ~~folly for cartes to say
for the creator to Make Empty space, is to doe~~ (In our
~~way of speaking)~~ /to doe\ ~~somewhat , but In truth Nothing; &
so a frivo~~ulous buissness. Nor is it a shallow thought
of ~~his~~ /D Cartes\, that Space without body is a Contradiction: ffor
Space must be Impenetrable, as body; for two Spaces Can=
not be Crouded Into one, and body is discovered & knowne
by No property but that, of /being\ Space Not penetrable. or
Extension, Into w^ch No other Extension can be thrust.
so it ffall naturally with him, to Conclude that body &
space were all one; and when Men talk of Empty Space
~~it is~~ /their notion is but\ a Chimera created ~~onely from~~ /by\ p^rjudice of sence, that
/so\ fills their Imagination; ffor the Image of Emptyness, as
~~to~~ /it is in\ our sence th~~is~~/ey\ translate~~d~~ to Nature; for w^ch there is No
reason; ~~becaus~~ /for\ wee ~~know~~ /fancy\ a vessell is empty (as wee Call
it) ~~becaus~~ Not /being\ filled with liquor, but Invisible air onely, ~~&~~
~~wee~~ /is no warrant to\ apply that Image of Emptyness to Nature, /so\ as ~~if a~~ /to
conclude\
/y^t a\ vessell or Space /might be as [well?] be\ without any body at all in it; w^ch
in

[65] The marginalium is in a tiny hand and wraps around the header from both sides at the top of the page.

phisick's.

w^ch In logick is a Non sequitur. it is No rare Elench[66]
In Naturall philosofy, to argue from sence to thing's, as
If thing's had such Image, as our sence Represents: ffor So
Men argued shapes & Colours to fly from body's to y^e
organ of vision;[67] & y^e like, w^ch late & truer philosofy has
Exploded, shewing the Image to be a creature of y^e Mind
occasioned by Sence, & Not subsisting without /us\. so it is ffor
vacuity, w^ch Men argue as possible, from similarity
with (seeming) Empty vessells, as If the thing were
possible [Ever?] y^e more for that fancy of ours. /or as If
colours must needs subsist in y^e dark becaus wee see them when its light.\

But yet in this point of vacuity, the p^rjudice is So
Strong, & y^e mean's of dissolving it so difficult If Not Im=
possible, that Many of our /late\ capitall philosofer's build
on vacuum as a principle, or Mean's of solving the
most considerable, & fundamental appearances. Wit=
ness M^r. Newton, who treat's space as a determinate
being, and call's it absolute, (that is Ever y^e Same or
allwais In y^e Same place), & Respective of other things
and then lean's on a more p^rcarious principle, of bo=
dy's Reciprocally attracting; as If the Easy steps of
cartesius, by Extension or body, devided & moved, were
Not poeticall Enough, & failed in y^e admirable, ~~so as~~ /~~&~~\
Not /having enough\ to divert the sectator's of Novelty, to whom plain[e?]
things, however aggreable to Easy truth, were fulsome
& vulgar. and tho he, and all y^e Modernes, that Im[=?]
pugne the Methods of Cartesius, use /his Method & generall hints of [Notions?]\ ~~them~~,
and In
truth his very words, but with an air as /of\ ~~If~~ their owne
Invention, yet one may see, a drift of contradiction /to h[im?]\
/in them all such\ as they say, Aristotle had to Cross y^e ancienter Naturalists
and Erect his fame /not\ upon truth, but Novelty.

And

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[66] i.e., an irrelevance, someting that does 'not follow'; an '*elench*' is the key part of an argument, the crux or proof.

[67] This is the idea that visual perception was by the reception of '*eidola*' or '*species*' (that the appearance of things actually arrived at the eye as a succession of film-like entities passing through the intervening space). There were several competing theories inherited from classical authorities, for example, Democritus and Epicurus had proposed the *intro*mission (i.e., the taking into the eye) of *eidola* (the same word is used to mean 'phantom'), Plato had proposed the *extra*mission (i.e., projection from the eye) of optical fire.

phisicks

And altho Mr. Newton In termes declines be/-ing\ Engaged
In any phisicall hypothesis, yet any one yt run's May
read his Mind, tho Not clearly Explained, wch is, that
the world at larg is a vacuum, and that here & there
is a Sun, & a planet /or so\ wch are kept in their places
by cross attractions, and that there ~~is~~ a/re\ centripetall
as well as a centrifugall forces yt affect them & every
part Engaged according to Quantity and distance; &
from thence let's himself into Mathematick specu=
lation's, wch are his Master-peice, and least want of
footing for his priciples, Should Endanger the frame
of his analiticks, he demands them to be supposed true,
as seeming Content If his deduction's & conclusions hold.
I am sure If he did Not beleev them true, he would
Never have laboured a mathematick Cours as he hath
done, that otherwise had bin as prudent as twisting a
rope of sand. However to doe him Right there is some
admirable Representation's of thing's, but the /very\ best are
built upon D. Cartes thoughts, /& without his failings.\

But yet I must observe that his warping of phi=
losofy towards vulgar prjudice, hath a great advan=
tage with ye Generality; and Such as are not practis't
extraordinarily with abstract thincking. And While Men
will hold with ye Majority, In Matter's Not experi=
mentable, such as the nature (Intrinsick I mean)
of body, and of plenitude or vacuum /are\, wee Must
Not Expect any other opinion a Match for them
but Submitt to ye very ffew, that are More Candidly
Ingenious.

phisicks.

But as to vacuity /or Empty space\ wee have this to observe, ffirst that
there is No need of it, & then It seem's It should Not
in any sence be created; ffor Motion Needs it Not, as
will be shewed when I speak of Infinite devisibility.
Next If it were att all, It could Not Reside with us
but In y^e^ center of y^e^ Mundane cour's, y^e^ Sun. for
all ~~that~~ hold that y^e^ Matter Moved, In orbe, receeds
from the center, & then the vacum Must Croud to
it, & there be at rest. And this also ans^rs^. the fancy
of Interspers't vacuity, ffor Supposing such a vast
force of Crowding outwards, If there were need of
small body's, It is confounded againe by that, ffor y^e^
Minute parts Turning about Instead of heaving
ag^t^ that crouding would be stopt by it. So that, upon
the Whole; it is a being created in Mans fancys, of
w^ch^ there is No occasion for, or use of In Nature, &
therefore Not, without some clearer proof, to be ad=
mitted.

Then as to the ~~Intrick~~ Intrinsick Essence of body, Whi=
ther all of it in y^e^ world have y^e^ same, & is Not va=
ryed, but according to Movem't magnitude & figure,
cannot positively be declared; but If wee May be
allow'd y^e^ priveledge of a Naturalist, to Guess where Can
be No experim^t^, I must needs say the reason carry's it
so. The chimist's contend ffor Saline, Sulfureous. &c.
property's of body; but their owne art Explodes all,
as any one may see y^e^ consults M^r^. Boyls sceptick chimist.[68]
ffor No body will hold its forme, but be susceptible of
almost

[68] Robert Boyle's *The Sceptical Chymist: or Chymico-Physical Doubts & Paradoxes, etc*, was published in London in 1661.

phisicks.

almost any, & yeild over & over againe the like
matter, & spirits out of Each devided species. I thinck
the controversie may be reduced to this point. If wee
can be satisfyed of the possibility, that body with its
modes & knowne property of being Impenetrable, May
Exhibite to us, all the appearances to sence, without
any Specifick & distinguishing nature of body's, some
from others, In the Essence of them; wee have No reason
to Invent any to serve turnes; ffor the plainer
& More single & Incomplex an hypothesis is, the more
agreable it is to Nature, (w^{ch} is Not In any knowne effects
& operation's perplext) and Glorious to y^{e} Author of it.
But If those Elements of Body devided and Moved
are Incompetent, wee must submitt to such as are
Inclined, to fancy & Maintain what Quality's they
pleas to Invent, so long as they Require No assent of ours.
ffor without demonstration Incontrovertible, No Essence
or Quality is to be admitted as a principle in philo=
sofy. And rather then doe it on lighter grounds, It is
Much better to profess Ignorance, & there rest. But it
is My opinion that wee Need Not doubdt o^{r} Caus
upon the principles of the hypothesis, (since Cartes),
Called, the Mechanicall. But it is to be tryed upon /Induction\
/or\ the success of the whole Systeme, & Not by other ar=
guments, deviding that point from y^{e} body of phi=
losofy, with w^{ch} it Must stand or fall.

phisicks.

Mr. Newton thinck's there is such a thing as Space
positive or absolute; wch is determined, altho all
body's are flitting; and being amongst them it is
Not possible to know wch move, & wch Rest. I know
well as long as we /orselves\ are body, and /are\ continually Sensi=
ble of other body's. wee cannot Shake off the Images
that are Infused from it; that is, vacuity, from seeming
(tho Not reall) Empty ness. And Space, from ye wise Exten=
sion of thing's. And time, from the ceasless succession
of Movements In the same Manner every day. And
lett a man argue his heart out, that, If body were
all annihilated, there would remaine, Neither Space
vist. here or there, Nor time, vist 'fore & after, he Could
Not Convince Either unphilosoficall Men, or Such as
will Not depart from Chimericall Notion's of Essences
and these latter have such a party of the others ~~that~~
to maintaine them, it is a bad Caus, they all oppose.
I appeal to any person that will thinck free a Mi=
nute, If there Can be time when all body, & Consequen=
tly Motion, of wch it is but a comparative account
is gone; and If this opinion In ye termes of it presseth,
he will yet say, he cannot Imagin otherwise, but
there Must be duration or time, wtever becomes of
body. I know it to be true, that wee Cannot Imagin
otherwise, & how Should wee that Imagine onely after
sence? but that argues Not it is so, becaus Wee
Such as wee are Cannot Imagin otherwise. I Say ye
Same of space. If all body be taken away, there
is No More Space, then time; the Notion of both
in us

phisicks.

/In us\ being wholly ye creature of sence, & that but a
copy of Extended Substance. Wherefore to My thincking
the Notion of positive fixt, or absolute Space, is a
chimera, for wch wee have No argument of force.

But Consider what follows; If becaus wee cannot
Imagin otherwise, Space must subsist without body
God almighty's power is Impeached; ffor say wee
that he were pleased to have otherwise; that there
should be Neither body Nor Space in ye world.
they that hold as above must say it cannot be so
for they cannot Imagin, but Space must exist
In all event. so space & time are made too hard
for the almighty. I bring this argument onely to
enervate the other; for If they say, It must be one
way, I ansr their ~~appea~~ reason hath ye Same force
agt the almighty's willing ye Contrary. therefore
wee have No reason to Contend for Essences where=
of wee have No Evidence, but If opinion must
sway one way or other, it is more reasonable
to carry it agt all fancy's of thing's bred onely in
ye brain, as Non Entitys; then it is from there to
assert ~~them~~, and build consequences upon the
supposall of them. for these reason's I Reject all
that Mr Newton Supposeth of space absolute, and
owne it onely as it is Referred to & is Measured by
body.

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phisicks.

Devisibility

Quantity's that fall under the distinction of
magnitudes are often practically devisible, but ever
mentally. for after y^e^ Effect of force Not succeding
practically to devide things, ~~is wanted~~ /[causeth?]\, the Mind,
putting in Imaginary Execution the like agents &
patients, Suply's the proposition; And this Is bound=
less In our Imagination. whereby from Exquisite
clearness of thought wee Conclude, all that is body
to be (mentally If Not practially, that is, with
due force, aptly applyed, If there were mean's for it)
perpetually devisible.

Wee have No reason to Exclude from Nature, any
propositions, w^ch^ are Not Inconsistent with Stated
principles, or Implying contradictions. therefore
It is that wee deny penetration of ~~substances~~ /bodys\
becaus y^e^ essence of body is filling place; but wee
have No reason to Exclude Infinity of Space /or body\ Either
In y^e^ way of ~~Increas~~ Extent, or deminution. ffor
boundless Extend doth Not att all contradict y^e^ Notion
or Essence as wee know, of body, or of Space, Nor /is\ It
any way Inconsistent, that It should be subdevided
perpetually. therefore If the arguments doe Not
reach to prove that Nature hath these Infinites
It is Most certein there is No argument to Ex=
clude them; for w^ch^ reason Moderne Sages have
bin Modest, and content to say Indefinite ra=
ther then Infinite, as less Cavillous or Quarrelsome

2. phisicks

But If the action's of the Materiall world are Such
as cannot exist without Infinte deminution, where=
by that side of y^e process shall appear probable
the other of Extent, w^ch No argument positive to
us Can reach, may more reasonably be admitted.

This matter is thus deduced. Our Naturalists have
bin at a loss to accomodate Motion without y^e aid
of Interspers't vacuity's. ffor say they; It is Impos=
sible thing's Can open, Shutt, & turne as they doe but
spaces will happen, less then any assignable, & then
there could Not be Motion, for want of parts Exqui=
sitely to fill them. this Is almost Current demonstration
<diagram> as. 2. bodies a. b. contiguous at a flat. d. c. Shall
make Space Infinitely small at y^e angle. c. &c. I dis=
solve this argum^t 2. way's. ffirst by saying that
Granting there is Not matter Ready aptly to fill all
angular Spaces opening, Motion would be No less
hindred with then without a vacuum. ffor the vor=
ticall Motion of y^e Mondane Matter about y^e Sun
or Center, Creates an universall crouding out=
wards, So as If any vacuity were, It Must be in y^e
center of y^e Sun; and [then'?] united force would
pack the small parts together, & they could Not
have force to Make way for Every litle Movem^t, as
farr as the sun's Center; the Consequences of this would
be a stop of the Minute Motion of y^e Exterior
matter, Growing neerer the Sun, till there onely
Would, If any where, be any fluidity

the other ans^{r}. is, that Granting that Matter is
devisible In Infinitum by Naturall possibility, I say
that If wee suppose it So actually Minuted that
In Every place where motion happen's, or at least
In Many or Most Instances of it, there is ready Mat=
ter Infinitely Small, to Enter the Smallest Spaces.
I mean No More but suppose, with Equall authority that
there are body's small enough to pack into it. And
I see No Inconsistency rise to oppose me. and then
motion is accomodated without vacuity's. I doe
not say that this or that Minute part may be
broken, or that it was other from the creation then
it is; but that there may be other's smaller &
smaller ad Infinitum. and If there May be Such, &
Motion, W^{ch} wee know, Requires it, why Should Wee
Not Conclude, as from a Most reasonable argu=
ment, that it is so? I am sure it is a better Cours
of hypothesizing, to solve appearances, by knowne
possibility's of Existent thing's; then to Invent
Existences, or Quality's to ffitt cases, & Resolve What
wee know Not.

The little puzles w^{ch} sofistical men have Invented
to Intricate this plain Notion of devisibility In Infinitum
are so puerile & trifling, they are not worth Notice.
and who pleaseth May find them in Most writers
of phisicks, but Eminentlty In Hales origination
of Mankind,[69] where y^{e} words Infinite & Eternity
are added substracted devided & Multyplyed at
the

[69] Sir Matthew Hale (1609-76), *The Primitive Origination of Mankind, considered and examined according to the light of Nature, ...,* London, 1677.

the pleasure of yᵗ Sage philosofer; I Shall onely
Endeavour to Make familiar to Sence that Noble
Instance of an hyperbole with its asymptotes, whose
property's to approach tho Extended to Infinite
but Never to touch. It seem's an hyperbole to af=
firme it; but being No less Strang & true and Der=
ving Exquisitely to prove the Infinite devisibility of
Space, take yᵉ following accᵒ of it.

An Hyperbole is the line Made In yᵉ sides of a
Cone, by a section paralell to the axis. as If a.b.c.
<diagram> Represent a Cone with a peice. e.f.d. Cutt
off by a plane paralell to yᵉ axis g.a. the
line e.f.d. is the Hyperbole. and the lines
a.b. &. a.c., being projected in yᵉ Same
plane with the section are the asymptotes. but
those Need farther Explaining.

<diagram> Suppose 2. Equall Cones to ly on
a level table, contiguous In their
cusps, & the axis of both in the
same strait line. then suppose. 2.
planes Erect upon yᵉ Same table
perpendicular to it, wᶜʰ shall touch the body's
of Each Cone, & Intersect each other In the Cusps.
these planes touching yᵉ Sides of the Cones [....?]
describe thereon by the Contact strait lines from yᵉ
cusps either way, wᶜʰ with yᵉ bases, make the two
triangles. a.b.c. & a.d.e: so that If the cones
are

sectioned by those lines of contact, the cones are
devided just in halves, and No hyperbole appears
but onely y^e 2. triangles. but If y^e section of y^e Cones
be paralall to them, (In this position, level.) then
the planes being also Sectioned by y^e Same plane.
the two opposite hyperboles appear, and also the
triangles (becaus the upright or touching planes
keep the Same distance tho y^e Cone draws to apart)
So by this In the plane of the Section, you have y^e
hyperboles, and y^e breadth /or figure of y^e cones\ projected; w^{ch} lines made
by the sections of y^e upright planes are the asymptotes.

Now it is plaine, that from y^e least part y^t can
be absinded thus from a cone to the greatest, that
is just Next to Equall deviding y^e cones, the asym=
tote lines come Neerer & Neer to be coincident with
the Hyperboles, and finally are so, & vanish. ~~Now~~
These Spaces of approach, are devisible In Infinitum
so that untill y^e Section be Exact In y^e axis, or Contact
lines there is hyperboles, but then None. and wee are
at liberty to prove the section may be Neerer then
any assignable distance. ~~that is~~ & yet Not Coincident.
But be it as Neer as you pleas, the part of y^e hyper=
bole at or towards y^e base shall be neerer the asym=
tote, then Neer y^e Cusp, w^{ch} still Subdevides.

But to augment the Representation, Suppose
these Cones, or Either Not limited by a base as
here described but Extended, and terminating
If I may So Say, In Infinite distance, the Same
is yet

is yet true. So after you have deminisht ye Space
of approach, between the section Making hyperboles
& that Making None, as Much as ye Imagination Will
allow, Carry ye cone cut to Infinite, and ye least (to so
Speak) point of space, is subdevided ad Infinitum by
the Continuall Appropinquation of the hyperbolicall
line to its assymptote, & yet Never arriving to touch
it. this speculation dissolves ye wonder both of the
Infinite devisibility of space, or (wch is ye Same) Matter
Extended in it, and of that property of ye /hyperbole with its\ asymptotes
ffor ye Case is ye Same of a conick section, whither ye
cone be small, or Never so great, cutt in like Manner
Nor is it less pleasant to know that the progression
of this approach of the hyperbolicall line to its asym=
tote, shewed by Extending the Cone to what length
of axis you please, Is in Geometricall proportion,
from ye Greatest distance, deminishing In Infinitum.
and draw ordinates /or perpends, at equall distance\ from ye asimptote to ye /..?\
hiperbole
pitch yr. 1. In ye Greatest distance. ~~pitch ye~~ or Where
you pleas, and one way Is Increas, & ye other demi=
nution ad Infinitum In Geometricall proportion.

<diagram> Whereby it appears that this In=
finite devision, is expressible as to
the method of ye progression; tho
No End can be arrived at.

This shall Suffise to observe as to the
Infinite devisibility of Space.

42r[70]

phisicks. c.

However ye Italian's were well Inclined to his
way of philosofising in other things, defyd him
in that, as appears by Severall letters of that time.[71]
This Made him Contrive a definition of Motion
under wch he Might evade, and prtend to Shew yt
there was really More of Motion given the earth ye
old way then his. but that Mumbling ye Matter
Gave out advantages agt him, by Quarreling with
his definition, Whilst his Notion is Inexpugnable.

His definition is that Motion is the translation
of a body from the vicinity of some, to the vicinity
of others wch are look't upon as Resting. Mr Newton
finds fault with this, and devides Motion Into ab=
solute, and Relative. the former is Referred to ab=
solute space, wch is Eternally ye Same, the Relative
onely, to the vicinity. this absolute Motion, is a
Notion wch is as hard to confute as vacuum. for it
is Impossible to expung the Idea of Emptyness, wch
is Imprest by that of seeming Empty vessells. and
from that Idea they argue the thing. So becaus there
is in the Mundane Systeme, here & there, with
Respect to body's of ~~Manifest~~ /Notorious\ positions, as /of bodys as\ the Earth,
its parts, & ye Starry host, therefore say they, there is
here and there in Infinite void Space. I Grant If
body's are in it, they distinguish place. but other=
wise /there is\ I may say, capacity of Space (Granting ye
void,) but neither here nor there /but all ye same\. As angells, &
Spirits, wch have No place, are as to body No where
prsent

[70] This page is not continuous from the previous - note that the numbering is now alphabetical and the topic has changed from devisibility to motion. ff 42-3 have been torn, just below half-way down. Reconstructive work visible across the opening ff 42v-43r.

[71] Claude Clerselier (1614-84) published the first volume of Descartes' letters (*Lettres de Mr. Descartes*) in Paris in 1657, two other volumes followed in 1659 and 1667.

p^r^sent but in power, that is they May actuate
this or that body, but Not by any Contact to de=
termine their place; Its enough wee know it is So,
tho wee know Not how. But Grant absolute Space
& absolute Motion, w^ch^ is the criterium. Wee Cannot
know. I may say y^e^ being of absolute space, is re=
ferred to body, and that of body Moved absolutely
to space. Ingnotum vel Incertum per Equale Igno=
tum vel Incertum.[72] Therefore altho M^r^ Newton
will have a great party on his side, In this excep=
tion to Cartesius definition of Motion, (w^ch^ is all
Relative,) of those who argue Essences, from the
modes of their understandings, yet I that owne
[~~...~~?] No ~~absolute~~ space att all distinct from body
may be allowed to take y^e^ other side, and owne
No absolute Space. And the Experim'^t^ w^ch^ M^r^ Newton
Introduceth to build his distinction upon (, tho Inge=
niously /made &\ described) argues Nothing to y^e^ porpose, as
I Shall demonstrate when way is Made for it.

Another thing, there is w^ch^ Creates great diffi=
culty. In Comunicating our abstract thought's
of any thing, especially Motion, And that is de=
fect of language. w^ch^ is beaten onely to ordi=
nary occasion's of life, and litle or Nothing In
Sciences but among artists, who doe /ordinarily\ agree termes
& know what one another Mean. Els the com=
mon use of figures confounds science, as in this
of Motion

[72] i.e., 'What is unknown or uncertain is made the equal of what is unknown or uncertain.' (My reading - no quotation has been identified)

of Motion. ffor who can Speak of it, but he Must
use y^e^ words, action, force, violence, &c. w^ch^ are
apropriate to ordinary use of things, & judged
by a Comparison with life, & spirit? so that If
you goe to perswade that a stone from y^e^ hand
hath Not an action, or life Impres't you May as
well argue, that the person throwing it is Not a=
live, but dead. Such a Similitude doe we give to
thing's moving, with /y^e^ Idea of\ our Selves when wee /seem to\ Move
The need of language in this Case, is so Manifest
that Even bulls pass ffor legitimate to serve y^e^ turne
as vis Inertia^e^. w^ch^ after D. cartes, M^r^ Newton
useth, to Express rest & Motion, to have No diffe=
rence as to active force. therefore I must be sensi=
ble that however clear I think, I Shall Not be clearly
explained In this discours of motion, untill having
fixt a standard of thoughts, whereto to Referr figu=
rate Expression's or termes, Such as, force, action. &c.
and then, by vertue of the Resort ffor Explanation
If need be, I shall become freer & bolder In Expression.

f phisicks

It is usuall to discours of Motion as Supposed In
vacuo, or In pleno, out of w^ch^ difference, Some de=
termine Notable points, as the Jesuit pardies,[73] ~~of~~
whom, and y^e^ Notion, I may touch afterwards, when
a stage is made to act adversarily upon. but at
p^r^sent I must determine that /supposing\ one way or other
the rules of Motion are y^e^ Same, ~~& proceed~~ /so\, Referring
the reason's to another place. And therefore I begin
with the Consideration of body In the Most univer=
sall and knowne state or property of it, Impe=
netrability.

And in generall I affirme that all ~~thing's that~~ /Imaginable modes & conditions\
~~can be thought~~ of body Consistent with Impenetra=
bility are, or May be true; And therefore Every de=
mension, figure, magnitude, position and alterat=
tion /In all degrees to\ ~~Imaginable~~ /& [Infinite?] In measure While place doth Not\
~~place Not~~ Interfer/e\~~ing~~ , May be
Supposed as true. on this depends the Mathema=
tition's ans^r^ to the sceptick cavil's, /who say\ ~~that~~ there are
No points, lines, squares, rounds &c. for ~~say they~~
they are in Nature, ~~If you could~~ /tho perhaps you cannot\ develop them, as
a statue is In a block, w^ch^ appear's upon chipping
away superfluity's /so being possible may be supposed to Exist\; therefore body May
~~rest in~~ /be supposed subsisting in\
[marg][74] any /certein\ distance or position /of parts with Respect to Each Other\ or
they may be in conti=
nuall chang of distance or position. w^ch^ chang
may be /in ~~by~~\, ~~Each body~~ /~~or both~~\ ~~altring~~ position, ~~as well as~~ /~~of parts~~ & Not\ dis=
tance, or ~~onely~~ distance & Not position /or both\ and those
In any degree /Infinitely various\ as space ~~(that is body)~~ /it self, on w^ch^ [all?]
depends\ & devisible
~~Infinitely~~, ffor all these are Consistent with
Impe=

[73] Ignace-Gaston Pardies (1636-76), a Jesuit scholar and author of *La Statique ou la science des forces mouvantes*, Paris, 1673. Pardies corresponded with Newton by means of the Philosphical Transactions of the Royal Society, notably arguing Grimaldi's theory of the diffraction of light in a discussion of Newton's theory of light.

[74] marg: 'use y^e^ Word posture.'

44r[75]

phisicks. J. j.

A. The first thing to be considered In order to Investi=
gate the rules that take place among body's Mo=
ving, (w^ch figuratively wee May Call law's, but really
are onely reality's Included In Quantity, and Neces=
sary consequences of Impenetrability,) is the direc=
tion. And when a single body is considered Moving
among others at rest, Must be allwais In a Strait
line, and Not in any Curve, & when curve direc=
tion's happen, It is from perpetuall caus, to be Con=
sidered hereafter; but the reason of this rectilinear
direction is that all part's of the body Must Mo=
ve Equally or uniformely fast, w^ch Can be onely in
a Strait line. ffor the parts of a body are affected
by Each other, so that it is Not possible to Excite
one to Move but all y^e Rest must Move. and If by
any Mean's, one part is Made to Move faster, the
Slower Retards y^e other, & those Excite slower, till both
have y^e Same measure of y^e Chang. As When body is
put in an orbicular cours, the parts Next y^e Center
move Slower then y^e Remoter. therefore While there
is Nought to Restrain the Cours of this body, the
outermost parts Shall draw the Inner, & these
Retein y^e outer, till there is Equality In all the
part's & Neither Works on y^e other. & this Is done
In an Instant of time, In w^ch y^e body is freed. I know
that the Caus of recess from centrall Movem^ts
& the going of in tangents is ascribed to this prin=
ciple, but there is More in it of w^ch in due place.

[75] If this is a continuation of the previous pages, which from the subject matter seems likely, then it is clear that one sheet is missing.

k. phisicks.

B. As in Quantity So In Motion. there is More & less
In all degrees of Increas & deminution to Infinite.
As when 2. body's chang their distance by ap=
proaching a third. and one toucheth it, when y^e^ o=
ther is Midd-way the former is say'd to Move
twice as fast. and /by\ this comparison wee have that
w^ch^ wee mean /by\, velocity, and time. onely velocity
considers y^e^ State of one body onely, but time is
a Continuall succession of subdevided ~~Moments or~~
movements Reducible to some Comon standard, as
hours, day's, years. &c. w^ch^ are but names Given
to periods of Motion, Symmetricall, or subdevided.
And as Every part of Quantity, or body is certein
and Comparable with Every other in y^e^ World. so
velocity is allwais certein and determinate, and
may be added sustracted Multiplyed & devided as all
/other\ Quantity, w^ch^ bring's movem'^ts^ within the sphear of
Mathematick Sciences, and is termed Mechanicks.

The Quantity of Motion is Compound of the sub=
stanc, and velocity. for, suppose 2. Equall body's
moved pasi passu.[76] It is true to say, the Either hath
the same degree of Motion; being Each a certein
Quantity & In certein & equall velocity. then add
these together, or suppose them one, the Motion is
Not by that Made less, and then It is true to Say, y^e^
Motion of y^e^ Compound is double Either of the Singles.
So If you double the velocity of a body you dou=
ble y^e^ Motion; and If you double the velocity

[76] i.e., 'in equal step'

of[77] ye Compound, the Motion of one of the Singles is
Quadrupled; becaus Each single with double ve=
locity hath double Motion; therefore In all calcu=
lates of Motion both the Quantity and the veloci=
ty are to be Considered, and a lesser body May have
as Much of Motion as a greater, If defect of Quantity
be supplyd with a par [.....?] of velocity. but a=
mong Equall body's, the Measure of force ly's wholly
In ye degrees of velocity, ~~but and In unequall.~~
<short underline/horizontal division>

Then Next If It be Inquired with What velocity
Shall body's part? I ansr, that It is universally true
that body's shall part with the same velocity as
brought them together, onely with this Exception, when
it Shall happen that there be movements after ye
stroke In the Same direction, one Must be Substracted
from the other, and then the parting seem's with So
much less velocity. Wch will be somewhat Explained
In the 3. fundamentall cases of Motion I am about
to State.

1. of ~~an Equall~~ /A\ body /moving\ upon its Equall /resting\. I say the
consequence is, that ye rester shall be Moved, with
ye velocity of other, & that shall Rest in ye place
of ye touch: Here they part with the same velocity
Wherewith they mett; and Each body hath a Chang
of State Equall /to ye ~~caus~~\ caus, vist Equall to Each other
for one yeilds whole/y\ to ye other, and the body Moved
hath as Much Motion as the movent had before
ye Stroke, & ye other aS litle as the body Resting had
vist None at all.

---

[77] This paragraph has a wavy line drawn down the LHS, with a short underline at the bottom, perhaps indicating its being excluded.

m. phisicks.

2. A Greater body moving on a lesser at Rest.
I say the less Shall move with the same velocity
as yᵉ other had before the stroke; ~~and the lesser~~ ffor If
Equall did yᵉ Same, a Greater cannot doe less.
And No ~~body~~ /movent body\ can give a greater velocity then it
hath, becaus Equall velocity is /a\ totall cession from
the stroke, & that supposed they could Never touch
therefore it Must be yᵉ Same. but on yᵉ other side, If
a Resting body doth but stop its Equall. It cannot
stop A Greater. but the Greater Shall Retein of the
velocity, ~~In such proportion~~ /~~It had so much~~\ ~~as the~~ /~~that~~\ ~~Motion afore in~~
~~it shall be to yᵉ Motion after it, as the It had,~~
~~In this propor~~ It had In proportion. visᵗ.

As. the Quantity of yᵉ Greater to yᵉ lesser
So. the velocity /of yᵉ Greater\ afore yᵉ Stroke to that Remaining
after

That is the remaining velocity, is proportionable with
the difference.

~~3. A lesser Movent~~

It is observable In this case, that When the /dis-\proportion
of yᵉ quantities are very Great, the[~~y~~?] ~~ordinarily~~ /body's often\ seem
Not to part /at all\ but to Move ~~on~~ /away\ together, /[wᶜʰ is not so tho yᵉ partys be
slow?]\ but it May be so
criticaly Supposed where yᵉ difference run's out to In=
finite therefore yᵉ Eye in such cases, ~~yᵗ~~ /not\ discern~~s~~/ing\ ~~Not~~
Small things, may be Mistaken.

phisicks n.

3. A lesser body Moving on a greater at Rest,
Here the parting with y^e former velocity, holds good
ffor it is Impossible the less, can follow y^e Greater,
ffor its Equall stops it In y^e point of Contact. And
of Necessity the greater Must doe more then that,
vis^t, make it Reflect in a Contrary direction. then
the greater must be Excited to Move but with
So Much less celerity, as y^e Quantity Exceedes.
and y^e other Reflect's with y^e Rest. as. A. is half
<diagram> B. upon the stroke C. shall Move with
half y^e velocity, & A. Reflect with half
so A.=2/3. B. that goes with 2/3 velocity
& A. Reflects with 1/2. ffor B. -1/3=A.[78]
and If y^t = stops, the + 1/3. Reflects it.
and likewise. ~~A + If the~~ = drives A. with
all y^e velocity, the -1/2 abates so Much.
/When y^e disproportion is
very Great such as may
be called Infinite as a tennis ball to y^e Earth tho y^e rule holds In [thato?], y^e
movem^t of y^e Greater
is altogether insensibly, & justly Reputed Nothing. & y^e less to Reflect with all y^e
former velocity
but of Re=
flections I
may speak
afterwards.\[79]

These 3. Cases of Motion are the groundwork of all
the rules of Movements, and therefore Should Not be trus=
ted to reasoning but If possible be proved by Expe=
riment; but Not like M^r Newton's for Motion ab=
Solute, the turning vessell of water, of w^ch the ~~use~~ /Inference\
/as with him\ may be Mistaken, but of body's themselves In the
very act of w^ch the Question is. ~~And If~~ I cannot
Say that a practik demonstration can be Made
of any proposition of weight & Measure, becaus
there is Error in all practis. but In this buissness

If

[78] Here, as elsewhere, RN uses the mathematical notation recommended in the prefatory materials to Isaac Barrow's *Lectiones opticae et geometricae*, London, 1669.

[79] This addition is inserted, as can be seen from the pattern of the lineation, between the two paragraphs, and in a tiny script.

o phisicks.

If it can be made appear that Without fail, [~~..~~?]
Equall stops & y^e^ other Equall moves with all y^e^
velocity, and Greater follow y^e^ less, & the less Re=
flect from the Greater w^ch^ also Move Somewhat
and as the differences are greater, the consequen=
ces are more apparent & Sensible, Since it is the dif=
ference of Quantity w^ch^ Induceth these various Ef=
fects, altho we cannot measure it to a Nicety, it
is a very cogent argum'^t^ that the Quantity Governes
in all to a nicety. I shall tell how I have Experimen=
ted these cases, & how any one disposed May doe it
with more Nicety. I have In an Ironmongers Shop, ta=
ken the hammer heads called Sledges, Greater small=
ler & Equalls. and managin by Swinging face to
face, I found the Effects afore described Ever happen
as Nicely as I could discerne; and the holding a
weight in hand all its passion's are more Sensible
to us then In any other ~~mea~~ method of observing
them. I appeal to the Game of Shufle-board, w^ch^
useth equall peices of Mettall Sliding, & often they
Strik one and other, and If the Stroke be diametrall
It allwais happen's (bating as Much variance as
May be ascribed to Inequality of y^e^ peices,) that y^e^
striker stops & y^e^ other goeth on with y^e^ Same Speed.
But If any one would Suspend Great weights, as
millstones, w^ch^ takes of y^e^ weights from hindring
y^e^ laterall motion /in\ a Small space /from y^e^ perpen^d^\ (for y^e^ rising is as
nothing) and manage these one ag^t^ another or
strike them

phisicks. p.

Strike them with knowne weights, a very Nice proof
might be gathered; I shall Conclude with a Comon
Spectacle blacksmiths for potts of Ale shew, one of
them Shall ly on his back, & set y^e^ anvill on his breast
& y^e^ other's forg an heat upon it, w^ch^ one would think
Should kill him y^t^ held it. but on y^e^ Contrary the Great
Iron anvil is Moved by y^e^ Small hammers So Slow
that the Impression is Not much. for it wants of y^e^
Swiftness of the hammers as Much, as y^e^ anvill is Greater
& that perhaps is as 20. to. 1.

Our Mechanick philosofer's have had a penchant
to Represent these cases of Motion as In vacuo, &
particularly Cartes, & Mon^sr^. Pardies. and then
find differences In pleno, from What they had as
they thought Establish't in vacuo. but In truth, as I
sayd it is all one. for lett us Suppose y^e^ Medium to
be Some Impediment to Motion, (for it is Not a totall
Impediment becaus all our knowne Motions are in
pleno, or fluido.) that Impedimen't^ is but as our ad=
dition to the Quantity, and If you suppose the Quan=
tity of y^e^ body as Much bigger, ~~as If~~ Equalling y^e^
Impedim't^ amounts to, y^e^ case is y^e^ same stated
Quantity upon Stated Quantity. and whatever Im=
pedim^t^ is, It works on both sides, for y^e^ body Striking
feels it as well as that struck; and In the Experi=
ment of y^e^ hammers, so solid is Iron with Respect to
air, It is scarce discernable, and If that of G^t^ Milstones
were Made Much less. And I am very sure the fluid
doth hinder but Not foreward a body in it, unless

it

q. phisicks.

Moves it Self all one way. besides the decision of
Motion Is in a Moment of time, In w^ch there is Not [~~Expected~~?]
ought Effective but y^e Quantity striking & y^e Resisting
whither composed of one or More body's. but the
manner of this Impedim't When I discours of fluids I
may better Explaine.

[marg][80] I have Recommended Experimenting these cases of
Motion because I have observed Great frailty in Reason=
ing about them. D. Cartes, who valued himself on his
argum'ts ~~w^eh he~~ as demonstration's, being as he say's,
Such as Engage y^e mind as clearly & distinct as these
of y^e Mathematitians, yet is ~~confuted by Experim't~~
Egregiously Mistaken in y^e Case of A greater body
Striking a less, Whereupon the less he Makes Reflect
alwais with the full velocity, & y^e Greater Not to Move
att all Cujus Contrarium verum Est,[81] being Sensible
of the fact, w^ch did Not Quadrate with his opinion
he charges that motion found In y^e Greater body u=
pon Such Stroke to y^e Medium, but In vacuo, he de=
termines otherwise, & his reason is, that the greater
having a surmounting force, Shall Not be wrought
upon att all; for If it can Resist y^e other, it Resists
it absolutely. w^ch is fals reasoning, for it May
Resist, but Not absolutely; ffor More Quantity Must
Give More Resistance, & less, less. Els the force of all
Greater Quantity's were (as to lesser body's) equall
w^ch to Me is y^e Same as to say Equall & unequall
are consistent.

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[80] marg: 'cartes
pardies.'

[81] i.e., 'Of which the reverse is true'.

phisicks. .r.

Mr. pardies hath Grosser failings in his theory of
Movemt; he took upon him to be a corrector of Car=
tesius, and failed ten times wors. Cartes was right in
his theory, and Mistaken in ye application to par=
ticular cases, but In the attempt Shewed ye World
ye way of gaining an Exquisite knowedg in that
Subject of Motion, of wch his cases, were but an Essay,
& had he lived I doubdt Not but he would have him=
self Corrected, and perhaps Given ye World a Systeme
of Mechanicks, as Excellent as his Geometry. but
pardies hath Mistaken In ye very theory, and abuseth
those Notions he borrowd of Cartesius. ffor Say's he, Every
body small as well as great, In vacuo, Moves every
other body it strikes, with ye full velocity. his reason is
that all body's are Indifferent to Move or to Rest,
and the least thing determines that Indifference.
and that body's Succeed otherwise under our obser=
vation, he ascribes to the Impediment In fluido. the
Shewing these opinion's, Is Enough to disproov them.
I might collect Many More Such, but I mean Not
to Comprehend the Whole subject, but to Walk thro
the principall path's In it, & therefore decline dis=
puting, as well as subtileizing, with Exquisite
calculation's; ffor If I can Shew what is true,
I need Not produce all I thinck Not so. And Geome=
trick calculates are Infinite, & proper for a genius
More retired, & Industrious In study, then I can be.

s. phisicks

Hitherto I have, as usuall Supposed the body's Concur=
ring, to be Regular & the direction & congress Exactly
diametrall, so as all the Substance, of both, are touch't
or concerned Indifferently; but there is litle of that In the
world, therefore If wee had No use of these cases of
Regulars, but of their like, they signified litle, whither
Wee understood them right. But I thinck they shew
a plain Method of determining any case of bodys
striking, Irregular, as well as other, & In any Man=
ner as can be thought or stated. And if this falls out
to be true, wee have made a Step beyond what
hath bin yet publiquely made knowne, therefore
I shall proceed In My attempt, be Shewing Some
plaine propositions.

1. That Every stroke of one body upon ano=
ther is by a point, or Reducible to it.

ffor If the stroke be by a line or edg. a. upon a
<diagram> superficies. b. the consequence is y^{e} Same
as If the Stroke were by y^{e} Midle point of
that Edg. a. /so if y^{e} stroke were by a superficies\ y^{e} Case is y^{e} Same, as If ~~the~~ /it\
~~stroke~~ were by y^{e} center point of it onely
as. c. upon d. for Whatever is argued
of diversion or alteration, from the Exten=
sion of y^{e} Matter one way, is answered by just as
much to act opposite from y^{e} Extent of y^{e} other way.
therefore I Shall Suppose all Impulses of body what=
ever to be from a point, upon a point.

phisicks. t.

2. A body fall's upon another with its full force
but in one certein direction.

As. Grant that A, upon B, hath its full or Greatest
<diagram> Effect coming In y^e line. a.b. It Shall Not have
so great effect If it Come In any other di=
rection as from. c. the reason that Respec=
ting the opposition In y^e Contact, they approach
Not by y^e line, e.b. In y^e [line?]. e.b. (ffor If they
did Not meet, all directions were alike) but
by y^e line. d.b. where the approach is in y^e
least time possible In that Swiftness of Motion.

I know after Cartes, all our vertuosi (litle thanking
him for his Invention,) make a body Moving to
be compounded of what direction's they pleas. as
here they would say, y^e Motion e.b. is Compound of
e.d and e.f. In y^e same time, Supposed so borne by
powers acting severally; and then they Suppose y^e
obstacle B. to be opposed to y^e Motion of e.f. but Not
to the other e.d. & so prove y^e ang. Incidence = to
ang. Reflection.

But I disowne all that process as arbitary & un=
cogent. for I Grant Such powers acting Severally
would give Such a path, but when No Such powers
act but onely a body under its own direction, What
Ground for such Imagination's of that w^{ch} is Not?

u. phisicks.

It follow's from this proposition, that there is an
Hemisphere whereof the direction of greatest Im=
puls is the axis or Semidiameter, according to w^ch
the force of the Impuls lessen's untill it ceaseth in
the diameter, where the bodys never Come to
touch; and y^e point of Contact is the center, as
<diagram> A. the body, B. struck.
c.d. y^e diameter. b. the center.
e.b. the axis, or Greatest Impuls.
f.b. an Inclined direction
f.b.d. the angle of Increas of the
Impuls, In the degrees from d. to. a.

f.b. Rad: f.d. sine ::[82] force from, f; force from. a.
This Hemisphear I shall call, of the direction, of
w^ch. b. Is y^e Center.

3. The hemisphere of direction, & Consequently
the axis or greatest Impuls, is determined
by the figure & position of the body struck
& Not of that w^ch strikes.
<diagram> The body B. In y^e former posture
determined y^e hemisphear[83] so as
a.b. was the Greatest Impuls, here
supposing B. turned on y^e center
being y^e point of contact, b. the line
a.b. is become an ~~Indi~~ Inclined direction, &
and Not as before y^e greatest, ~~w^eh is In the axis~~
~~m.b.~~ therefore tho y^e Impuls comes from d. y^e he=
misphere. is d a m. and Not a m c. or any other

---

[82] As noted above, throughout the MSS RN uses the mathematical notation recommended in the prefatory materials to Barrow's *Lectiones opticae et geometricae,* 1674; the symbol '::' is employed by Barrow to mean 'eandem rationem habet', i.e., 'has the same proportion'. Isaac Barrow, 1630-77, was at various times (and with interruptions) Regius Professor of Greek at Cambridge, Gresham Professor of Geometry and fellow of the Royal Society in London, and (the first) holder of the Lucasian Chair in Mathematics at Cambridge which he resigned in 1669, to be succeeded by Isaac Newton. He was Master of Trinity College, Cambridge, previous to RN's brother, John North. RN, who knew him well, only ever mentions him with respect and affection.

[83] RN varies the spelling of 'hemisphere' randomly through the rest of this essay.

phisicks. w.

Hence it is Manifest, the alteration of the Impuls
by Inclining y^e direction, Is onely In More or less
of force, as if the body that Strikes, had less Subs=
tance, or less velocity, as y^e Sine of y^e Inclination is
to y^e Radius of y^e hemisphere.

4. The direction of y^e body Struck is the Same
from what point of y^e hemisphere, So Ever
the direction of the Impuls is.

This is but an Instance of y^e former determination.
but it will Easily be conceived, If wee Reflect that
there is Nothing but an Inconsistence of the Mo=
ving state In y^e way it is in, at y^e Instant of Con=
tact; from whence Soever it comes. and More or
[marg][84] less of force, doth Not vary the directions w^{ch} Must
be y^e Same, In less, as In More force of Impuls. W^{ch}
latter onely falls out upon Inclined Impulses.

5. The direction of the body Struck, is Such that
the Whole Substance of it Shall Recede from
the ~~hemisphere of y^e Impuls, by the~~ /strongest Impuls y^t can be on that point has y^e\
largest
steps, and so as all the parts Receed Equally
or uniformely.

This proposition, Going into Cases of Irregular
body's as well as Regular, hath Many vari=
ety's, and first of the Regular.[85]

---

[84] marg: 'prop.' i.e., identifying a proposition in a proof.

[85] The whole of the shaded area has been struck out with diagonal lines.

x. phisicks

of all Regulars the Globe is Most perfect, Next
yᵉ Cube. the consideration of wᶜʰ two, will I conceiv
open a way to clear others. and first of the Globe.
<diagram> let that be Struck upon any point
and with any direction I shall Move
allwais by a line that passeth the
point of contact and yᵉ center of
the Globe, ffor that is the strongest Impuls that
can fall upon that point visᵗ the line a.b. and In
So doing keep allwais uniforme degrees of Recess,
It Cannot happen otherwise, ffor what should deter=
mine or Make one side of yᵉ Globe receed.
/The line of motion, or direction, is yᵉ path of the
center, /&\ \of yᵉ moving body/ ~~The direction of the body~~\[86]

Therefore, Since the Impuls May come from any
part of yᵉ hemisphere, and give to the body Struck
all the same direction, I Shall call yᵉ axis of the
hemisphere the direction of the contact, as /to this porpose\ Including
all other contact's yᵗ are possible. and yᵉ point of
Contact for position shall be considered as the Ex=
tremity of yᵉ line. ffor Imagine the Hemisphear
to deminish Infinitely so as to determine in the centre

~~5. The body Struck Shall Move In such di=
rection as Shall Continue the~~

wᶜʰ is yᵉ point of Contact, that propells, the force
must be look't on as most Indifferent to the Whole
& to Come in yᵉ line of the axis. Wherefor it is just
to determine, that from what point soever of
yᵉ hemisphere, yᵉ force comes, the propuls is as by
yᵉ axis.

[86] The shaded area struck out with diagonal lines.

phisicks. y.

All contacts Must be either on a plane, or Curve
If upon a plane, the ~~line of~~ the plane /itself\ is the /base or\ dia=
meter of the Hemisphere: but If upon a Curve
then the tangent /to\ ~~of~~ y^e^ Curve ~~in~~ y^e^ point of Contact
is the base or diameter. If the body's are Exquisitely
shaped y^e^ Case is plaine In both, from y^e^ foregoing
description of greatest Impuls. but If the bodys are
Compound of Many part's, or Mear rugged coa=
gulum's yet If they have had any sort of [leviga=?]
tion the case holds ~~trew~~ true, becaus the laterall
part's maintaine the fall to be on y^e^ face point
onely to be touched. as If the body fall obliq on
<diagram> b. the prominences being all Equally
high depend from all Strokes but What
are upon diver's, as a flat or plane
the like holds in Curves. and altho
nicely speaking, No figure is Exquisitely regular,
So No Impuls is Exactly as Globe & plane, or plane
to plane, but more or less swerving; yet in y^e^
Main y^e^ Irregularity falling in one as well as y^e^
other, & sometimes one way & Sometimes another
with anomaly's Insensible to us, Wee May justly
Enough, In theory, Suppose body's Exquisitely re=
gular & polite.

z. phisicks

5. The body struck Shall Move In a direction
as Neer continuance of the line of contact
as Is consistent with, the uniforme recess
of /all\ the parts; and where that May be, It Shall
be Exactly y^e Same line Continued.

This May Suppose y^e body Struck to be regular, &
Impelled upon some diameter, or Irregular. the
former will be Most plaine. as first In case of a
Globe, w^{ch} is regular & cannot be Struck but u=
pon a diameter, as y^e Globe. c. struck upon y^e
<diagram> point B. shall Move in the line
c.k. w^{ch} is Continued from y^e
line of Contact. a.b. and the
parts d. and e. reside unifor=
mely from y^e point of contact. b. as when y^e Globe
is at K. they are perpetually Equidistant. as
at b.m. and b.N: it is also to be Considered
that there is No caus to determine either to goe
of faster, as at p. y^e line b.O. is longer then b.p.
and ~~there is~~ y^e Same caus /might as well\ ~~to~~ carry it y^e other way.
therefore it Shall Goe between both, vist all the
parts keeping perpetually a parity of distance
In their Motion, on y^e one side with y^e other, w^{ch}
I may call an Impuls balanc't.

<diagram> the like is true of a cube, w^{ch} the
same caus of Reasoning proves.

phisicks. aa.

But If the body Struck is Irregular /or the Stroke is Not on a [diamatur?]\ Whereby
the part's of it are Not In parity of distance from
y^e point of Contact. ~~but one way are Removed~~
~~more then y^e other~~. so as Moving In continuance
<diagram> of the line of Contact
they shall Not all re=
ceede uniformely, but
some faster then others
Then the direction must break from the line of
contact and y^e body Move so as all the parts Shall
have uniforme Recess, w^{ch} [)?] Shall be in a line
continued from y^e point of contact thro y^e most cen=
trall point, called y^e Center of Gravity. As
a. the striker.
b struck. c. the center.
a.b. the line of contact
b.g. the continuance of it.
c.e. the same by y^e Center.
b.d. the true direction, from y^e Impuls at b.
g.b.d. the angle of y^e Refraction.

If this Rule holds universally, as I thinck it doth,
that upon Every ~~anomalous~~ Impuls ~~upon an~~ /Regular &\ Ir=
regular ~~body~~, the progressive direction /given\ Shall be
by a line passing from the point of Contact thro
the center of the body /struck\, Wee have a Theoreme In
mechanicks No less considerable then New.

ab. phisicks

I Must declare that I propose it as a hint onely
and as farr as I can observe from Comon Movem^{ts}
of body's, conforme to them, but I doe Not attempt
Nice demonstration, but leav that to y^{e} Curious
Since it is well worth their Scrutiny; I shall onely dis=
cours it as of a thing probable & In a phisicall Way.

The protrusive force, passeth from y^{e} point of Con=
tact to all the point's of a body struck w^{ch} is done
by strait lines, becaus I suppose the body /tho Compound of others\ united to=
gether as a coagulum. yet y^{e} force passeth by right
lines. If wee could Suppose any one line to be a Small
capillary cillinder, & perfectly loos with its Extremi=
ty In the point of Contact, that would Shoot forth.
If a Curb. or a hoop be struck, tho the part ly round
yet the protrusion is by right lines; every one of w^{ch}
would if It might be from y^{e} Contact. Suppose a Con=
<diagram> geries of very acute angular pyramids; Exquisitely
meeting or having but [on?] comon cusp or point b.
but all loos, & No way Glued or united together.
and an Impuls comes upon this comon Cusp.
It is more then credible Every part or pyramid would
start forth In the peculiar directions as If they were
Severally Struck on their Cusp directly, that is by
the lines c.d.e.f.g.h. as was Shewed of Regulars.
and then Suppose all these Coaguled Into one Solid
pyramid, the part's are protruded and have y^{e}
same tendency, vis^{t} to Spread Every way In direct
~~lines~~ lines from y^{e} Contact.

~~phist~~ phisicks ac.

<diagram> Then let y^e^ body be Irregular. & y^e^
contact on a point Contingent as at
b. there are Infinite pyramids, W^ch^ Wee
may consider as so Many lines of di=
rection In w^ch^ this body Is thrust. It Can
Move In but one; and What can that
be, but that wch is a Medium of them
all? w^ch^ I say passeth thro y^e^ center of Gravity. c. so
as c.d. shall be y^e^ Effectuall direction, or path of y^e^
center. c. I should be Glad to See [~~but~~?] a demonstration
of this, or of any other y^t^ bidds fairer for it.

This setled, wee have another hemisphere Given ~~to~~ /In\
w^ch^ the protrusif force dilates. W^ch^ I may Call the
hemisphere of the effect. ffor the parts of a body struck
are protruded to Every point in it and what are
loos, as I observed will go accordingly.

All that applyed to the /hemis=\Sphear of y^e^ Impuls, Make
one Intire Spear, w^ch^ I may Call y^e^ Sphear of action.
for they have one Comon diameter, and y^e^ line of Im=
puls (another y^e^ diameter) I call y^e^ axis.

I observed before that Inclining the Impuls lessened
y^e^ force of it, on that side. So Now on y^e^ other Side
I must observe that those part's w^ch^ are In or Nee=
rer the axis or direction of the Impuls, have More
of the protrusive force. this is but the Revers of y^e^
former, and hath foundation In y^e^ Same Reasoning
for

53v

ad. phisicks

 for a body that goeth from b. to
c. Must Move faster to Make Way
for a. the one from b. to G. In ye
proportion of the radius ~~to~~ b.c.
to ye Sine ~~g~~ g.h. and a Greater
power is Required to give such a velocity to. c.
as Shall ~~recede from~~ /yeild to\ ye Stroke, then to g. for g. by
Moving Slower the ye force, vist g.h = b.f. shall
become No opposition; but to c. It must move
away with ye ful velocity, to ansr way to ye force.
And In Regard Such parts Require a greater velo=
city, the force is More effective upon them. And this
holds In all degrees throout the hemisphear of Effect
Whereby the parts In the axis are Most protruded
and those in ye diameter least or Not at all.

 let us Imagine an whole hemispheer
of ~~pira~~ Equall pyramids Small usqe ad
Infinitum~~, and~~[87] Joyned In one Cusp, and a
force fall upon ye point a. ye Comon Cusp.
all these pyramids Shall move away In
their proper directions b. c. &c. but
with different velocity's. at. b. that of
the force (supposing it prvalent) but
towards $^{d.}_{e.}$ $^{c.}_{f.}$ & $^{b.}_{g.}$[88] Either way, Even
to ye dameter, where ye velocity will be litle
or Nothing, and Exactly in or beyond it
Nothing att all, becaus In a degree opposed to
ye force.

---

[87] i.e., 'as far as infinity'.

[88] On this one occasion RN sets the letters one above the other (it cannot be done in this word processor). He seems to be trying to express the same line between two points (i.e., 'a.b.') as if he had put the letters side by side as elsewhere.

phisicks. ae

to y^e^ force. that is without y^e^ Greatest Inclination
of y^e^ Stroke as I Sayd before.

There is Nothing forc't In this conceipt, but wee
ought to look on body's bound together, to have y^e^
same tendency's as If free, but y^e^ binding May hinder
the Effect y^t^ would happen if loos /becaus, severall body's are Compounds & Must have
a Compound Effect\ therefore a body
may as well be Considered with its parts composed /~~becaus what otherwise was generally~~
[~~sic~~?] ~~is compounded~~\
as If it were broken Into devided parts, ~~so as those~~
as to the tendency of them. And as here wee suppose
[~~a Sp~~?] an hemispherick forme, all that is true of that
will for the part be true of any portion of it, as
for Instance the wedg abscinded, as In y^e^ figure ff. h.
the part's of w^ch^ are Influenced by a stroke as /while part of\ the
whole /they\ would have bin, as to all tendency. W^ch^ If bro=
ken Into unequall piramids as before, If the Experiment
were practicable would appear. then it will follow
from two Considerations, that this body Must turne
round. ffor 1. the parts F.B. Move towards B.
and those at h.~~g~~/k.\ towards g.f. not opposite to y^e^
other, So Not hindring, & Not following, w^ch^ Can
have No Consequence but turning. And that is the
consequence of uniting body's for If loos Some
parts would Move faster then others, /~~and are~~ [~~not~~?] ~~paired with others~~ [~~like~~?]\
having Such ten
dency from the Stroke /and Not paired or balanced by others\; when united, ~~& Must have~~
/so to have\
a Compound Motion, It cannot be otherwise then
by turning Round. So here is opened a New Scene
of matters to Speculate, turning & progression in
y^e^ Same body, & how they Consist, of w^ch^ Next.

54v

af. phisicks

1. The turning of a body, is a State or Mode
w^ch (as progressive Motion, or rest), will Con=
tinue for Ever, If causes Intervene Not to
alter it.

2. The turning of a body, is a Continuall
chang of posture, & progression /a Continuall\ chang of
distance, with Respect to Such /other bodys\ as you are
pleased to Regard as Resting.

3. Those two Modes are No hindrance to
Each other, and In No sort dependant
but May be /created\ accellerated or Retarded
without any ~~cross~~ /opposed\ Influences ~~att all~~. as
If a topp be set up on a board. that /board\
May be Removed without any hindrance
to y^e turning. so the turning Is No Impe=
diment to the progression, Nor that to y^e
turning. ffor both one and y^e other have
No Essence but as Regard is had to other
body's, w^ch May be so varyed as to Make
Motion rest & rest Motion. And Since by
Mean's of Such Regards, wee have the
Idea of turning, Wee have it also as In=
dependent of all other Regards, by w^ch Wee
doe In like Manner determine of pro=
gression; And Nothing can hinder this so
long as both these Modes, Independent
of Each other are Consistent With Impenetra=
bility, the test of all Corporeall possibily's

55r

phisicks ag

~~34~~. Every body that turnes In a free Medium
must turne upon the centrall point, & No
other, however the turning Motion is Im=
parted. W^ch^ center Is hard to Investigate in
Irregular body's, but all agree every forme
Whatever hath Such a point, on Every Side
of w^ch^ the Matter is one way or other ballanc't
or of Equable force.

The reason of this is: that If some part's Move
faster, that is If one side of the diameter (choos
it where you will Either, perpendicular level [&c?])
move faster, all taken together, then y^e^ parts on y^e^
other Side move Slower, & Consequently Must ~~Retard~~
work upon Each other, by /~~opposite~~\ Quickening [~~Els~~?]on y^e^ one
side y^e^ Slower, & ~~accelerating~~ [Retarding ~~to~~] on y^e^ other Side y^e^
Slower till there be an Equability /of [fore?]\ on both Sides
ffor the part's of a body are all Influenced by eve=
ry Motion Imprest as one body Influences another
and as upon the Instant stroke of 2. body's, they
are as one and y^e^ chang of states Goes according to
Quantity, So the parts of one body Cann have No
chang w^ch^ is Not throly Influencing & equally
or uniformely disperst thro all.

5. This giration Is determined as force itSelf
distributed, In one and y^e^ Same Instant
of y^e^ Stroke.

ffor that w^ch^ is done between two body's Striking is
also also determined to y^e^ part's of each all In one
Instant & for y^e^ Same reason.

ai.[89] phisicks

<diagram> 6. By how Much the progressive fore is demi=
nished by placing ye Contact by So Much is
the giration Increased. & E contra, as When
a Stroke falls upon the very point of a Romb
laterally, It Shall have No Motion but tur=
ning. but If it fall upon a diameter, It shall
have all progression & No turning.

The Experiment of this is ffully Made by the
puerile diversion Called, Catt, wch is a peice of wood
of this forme, and upon a stroke of ye battoon Shall
turne With Incredible Swiftness, & Not fly away,
but Struck upon ye body, Shall fly off & Not turne
and Intermediate strokes have Corresponding Effects

<diagram> The proportion's of this distribution are
according to the position of Quantity and
so are very hard to Calculate. ~~but are So~~
but May be done, If the state & position
of the force & Quantity be admitted, & ye Center
knowne; but I am Not a match for Such under=
takings. onely thus farr I may declare.

That there is alwais a part of the body Struck
wch if free would move In ye direction of ye Impuls.
as. be f. e. the axis or direction of ye Impuls,
take the less part a. b. c. on one side, & its Equall
a. d. c. on the other. these two, ye Rest away would
move In ye axis, c. e. as that prvailes the turning
is less, and as it is prvailed upon it is More.

---

[89] RN's alphabetical numbering appears to go from 'ag' to 'ai'. This might be be a writing error. But note that the following page is 'am', implying a *real* gap (confirmed by the reference back to an apparently just-discussed topic on proportion).

56r

phisicks. am.

This proportion is better accounted When the
body Struck is Regular, but Extended very Much
in length. ffor then a plain devision of a line
<diagram> Gives the proportion, as If the body
A.D. falls on B (inexpugnable)
at. C. 1/4. then to Goe on there
in 3/4. and to Stop or Reflect but 1/4.
So If B. falls upon. C. there
is 1/4 of y^{e} Quantity to Goe towards
A. & 3/4. to goe towards. D. there
fore the 3/4 shall hold ag^{t} 1/4. In that
proportion. if the body were devided
In halves at. F. then Equall to Equall
ballanceth & y^{e} whole must Goe to. E. /w^{ch} is. 1. to 1.\ but
~~If fo~~ If to 1. you ad 2. More then y^{e} odds is 1/3.
If the Substance of the body be drawn In length
and Irregular as the figure is all the Quantity
that is added towards. D. disorders y^{e} proportion.

Hence It is found true ballances, Cannot be Made
but In proposition of an uniforme body, & y^{e}
forces falling In a strait line, but of Such [matters?]
apart.

Here is y^{e} reason Why a solid /thick\ body struck tho long
shall Not turne Much Nor be very Much Refracted
but a very long body struck towards y^{e} End Shall
turne almost all, and Refract very Much.

56v

an. phisicks

 These. 2. ~~power's, or~~ Effects of turning &
Refraction of the Progression, hold upon y^e^
same principle, that is the position of the
Matter in y^e^ hemisphere of y^e^ Effect. but
When the body is Reduc't to a line, then
No part is advantaged by position in the
sphere, becaus it is Supposed to be In y^e^ very
diameter. and to draw directly opposite
as. K. towards C. and D. towards. L. w^ch^
bring's the proposition to the devision of
a line. and y^e^ force yeilding or resisting
in y^e^ parts on Each side, are In proportion
to their length. but If the Quantity have
place otherwise in y^e^ hemisphere, of effect
that is Not so.

[marg][90] As for Instance If A. falls on B. at y^e^
 point. c. the stop hath an efect deter=
mined by y^e^ place & Quantity of y^e^ parts
in the hemisphear of effect. but If you Move
y^e^ point C. In knowne proportion Either
way, the Effect Shall Not hold like propor=
tion, for the reason is Not so. but If you
take a Midle line ~~de~~ d. e. and contrive
the stop shall be on that; then as you
vary y^e^ stop one way or other the effect
shall hold proportion with y^e^ length's. ffor
they are as In y^e^ diameter of the hemisphear

---

[90] marg: above the diagram '*q*^u^', and below the diagram 'is ther progression or No.' (neither of the marginalia refers to the diagram, rather to the text). I read '*q*^u^' (here, and elsewhere in the MSS) in agreement with Jamie C. Kassler (*Seeking Truth. Roger North's Notes on Newton and Correspondence with Samuel Clarke c. 1704-1713*, Ashgate Publishing Limited, Farnham, 2014, p. 10) as an abbreviation of '*quaere*' meaning 'enquire', or as we might say 'to be checked out'.

<diagram> phisicks ao

becaus the Quantity ly's Equally on Each
[marg][91] side /of y^e diameter half\ towards A. and /a half\ towards B. ~~and~~ /so as\ one
voids y^e Effect of y^e other as to tendency's
from the /point of\ contact. becaus If some goe they
must draw others.

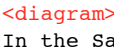
There may be body's formed, to work as In a Strait
lined Impuls or oposition; but I Enter not Into this
<diagram> till I come to the cases of Mechanicall powers.
onely take this proposition), of Compound
strokes, w^{ch} [~~are~~/is\?] y^e foundation of all them.

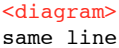
If 2. Equall forces fall at the Same
time upon severall parts of a body,
the ~~direct~~ direction's of w^{ch} will Not
fall in y^e Same line. the body Shall
have ~~Moth~~ Motion both progressive and
turning, as In y^e lower fig. but If in
the Same y^e strokes void Each others
Effect In y^e other.

The case of direct opposition is plaine, for y^e
other. the direction of A. is. A.D. and of A. is
H.E. the axis if y^e stroke A. is A.B. and that
of H. is H.C. therefor the direction Shall be
mean, as [~~..~~?] O.K. deviding y^e angle of the 2
axes, In proportion, as the axis-direction is More
or less p^evalent. but y^e turning Shall be double
for both stroke (In this fig) concurr in Effecting that

[91] marg: 'prop.'

ap. phisicks

 If the Strokes are opposite, but yᵉ [directions?]
In the Same line ~~the~~ /but also\ opposite, the body
shall turne all, & Not be progressive at all
as In yᵉ figure.

 If the strokes are opposite but upon the
same line, and the body Regular, the
powers shall be as their distance ~~in~~ /from\ the
Midle point.

Here is ~~Not~~ no progression from Either but all
turning and as was Shewed yᵉ Same diame=
ter is comon to both hemisphers of yᵉ opposite
Effects.

phisicks

of power or force.

Having done with principles of Motion, In w^{ch} I
have declined words of Comon use, becaus they Carry
a p^{r}ventive Construction, and folks ~~are apt to~~ using
them In ordinary discours, ~~therefore~~ doe Not readily
distinguish their force when philosofically applyed.
As Comonly by force or power, Men Mean Some In=
terne principle of action, as animalls have, & So
for Weight, & other practick cases of Motion. but Wee
Must /also\ use them, but Meaning No other then the Mea=
sure of Change w^{ch} body's upon Moving occasion
as before hath bin discourst. therefore wee Say a Great
body hath More force then a less, Not for any [Essen?]=
vertue In it, but becaus upon Collision, the other
Gives way, & that is /but\ litle stopt in its way.

This Case of Quantity, varyed as before, is the founda=
tion of all the calculates of force. ffor whatever
the quantity's are, or the celerity of meeting; If
the Substances are /In\ y^{e} Same /proportion\ (y^{e} Strokes /~~& [shapes~~?]\ I allwais
suppose
diametrall or full), as 1/1 1/2 1/3 2/3 %c. the separation's
are Exquisitely y^{e} same. ~~but If you compare~~ So y^{t}
considering 2. body to Meet the proportion of their
substances, determines the Effect of a Collision. So,
that as one substance to y^{e} other so y^{e} celerity /wtever it is\ after
to that afore y^{e} Congress. but If you will Compare ~~the~~
/these\ body's after or afore, with any other's, supposing
there is to be in congress with them, & would know
the Speed, or chang as will be produced. then you

must

phisicks

you Must take into y^e^ account the celerity of that
you Estimate by, ~~as~~ for it is Sure a greater celerity of
congress between y^e^ Same body's Gives a greater ce=
lerity after it. therefore If one body falls on another
with 2. degrees of celerity, It shall excite a greater
Swiftness then if it fell with but one. And If it fall's
upon a Greater Quantity, It shall excite a less
celerity then If it fell on less Substance. but If you
will Say by what degrees, or Compare the Consequent
~~cle~~ celerity with any third Stated. It is Necessary you
know as well the proportion's of the substances to
act, as the swiftness with w^ch^ they act, & then a due
Estimate of the Consequences may be Made by all
w^ch^ it appears, that force ~~in~~ /~~y^e^ same~~\ ~~body's~~ is compound of
substance, and Swiftness: and ~~that In severall ones~~
Swiftness countervailes substance, & E contra. that is
a body with 2. grad^s^ swiftness Shall Excite /in another\ double
y^e^ celerity as that body Should with one. and ~~one~~
1. degree of substance with double Swiftness Shall
doe y^e^ Same as 2. of substance, with one of swift=
ness. the like as to opposition. for whatever Swift=
ness would be Excited by any one Stroke, upon a
determinate Substance, double y^e^ Substance, & the
Swiftness will be subdubled, or half. So If body's
meet both Moving, the velocity's are added to=
gether; If unequall, the Greater p^r^vailes accordingly.
so If they persue, with less celerity In y^e^ foremost,
that is to be subducted out of y^e^ other, & Remain
untouch't.

phisicks

untouch't, and for y^e^ Rest, chang Made In y^e^ Congress
with y^e^ Remainder. Upon this theory, May be framed
Infinite variety of Cases, as Geometers pleas to Exer=
cise their Subtilety, but I Am Not Guifted that Way
nor Endued with a Retired patience as they Must be
who advance In Mathematecall Study's. So to them
wee leav that province, and I lay hold onely on that
usefull part, as Subserves my phisicall porposes, to
Make Naturall thing's, admirable to view, be fami=
liar & plaine to y^e^ understanding. In order to profit so
by this theory of Motion; I Collect this universall
rule or Maxime.

By what mean's Soever Movem'^ts^ Can be oppo=
sed, and there be difference In their celerity', the
account or Effect of y^e^ force, shall gaine as Much
by y^e^ Celerity, as by Quantity, & they will Recipro=
cally ballance or Exuperate Each other, according
to y^e^ Measures of them.

Or More short thus.
In all opposed forms, dispatch answers ~~force~~ /substance & contra\,

That is, w^ch^ moves faster, hath So Much advantage.
So that universally In practis, If you are Content
to loos time, that is goe farr about, you May doe
any thing with any force. ffor as In Single Strokes
celerity augment's the Effect, for More will have More,
so In ~~continuall~~ Motion's opposed, that w^ch^ is y^e^ Swifter
hath so Much of advantage. becaus y^e^ body So Swift
out of y^e^ frame, as well as in it, hath so Much More force,

phisicks.

I Need Not be so particular as to apply this discours
to the comon mechanick powers used In y^e world, w^ch
are 5. the lever, screw, wedg, wheel, & . . . .[92] all w^ch
are but contrivances to Make the lesser power walk More
Space then the greater, and accordingly it is Made More
Efficacious, ffor this is of Comon observation. and hath
its demonstration from this plaine axiom, that the
force of Every body is augmented by acceleration. So
all other Contrivances y^t ever were or will be found
out In the world, for Giving advantage to a lesser
power over a greater, will lean wholly on y^e same
therefore Mechanicall men are of opinion that
Engin's are of use onely where y^e force is had Gratis
as wind or water, or nude force of Men Cannot be
applyed as to vast Solids. ffor If you [buy?] y^r force, you
Gaine litle or Nothing by y^r Engin, but what is a=
gaine lost in time.

If it be objected as I have knowne some say, that the
case of solute Motion's of body, do Not prove the
case when put in frame as In Engin's. but say they
the fulcrum of an Engin is that w^ch distributes y^e
force, becaus that w^ch is from y^e [frame?] a looser, is
neerer y^e fulcrum & More stopt by it. as where the
<diagram> force a. falls at c. is Neerer & More resis=
ted by y^e fulcrum. e. then at d. where y^e force
b. falls. therefore ~~be~~ b hath an advantage
by this Engin. I say the case is all one. the
frame doth but sett y^e forces in opposition. for
Neither can proceed, without one yeilds; so that at
y^e

[92] RN momentarily forgets the fifth 'mechanick power' and leaves a space for the word (which would be 'pulley'). The idea of 'the five mechanic powers', like so much else in RN's common sense mechanics, derives from Archimedes, or 'the Hellenistic tradition', and often *via* Hero of Alexandria (10–70 CE) (this was so commonplace as hardly to require specific citation). *See* below f. 148v; *see* also note in BL Add MS 32546, f. 22r.

ye Instant of the stroke, there is as Mutuall an oppo=
sition, as in Single Impulses. and If the greater yeilds
a less speed will make way then If the lesser yeilds
for that Must Move More space, yt is faster, as the
engin Is framed; therefore the less celerity shall ra=
ther succeed, If ye other force be such as with its ad=
vantage Suffiseth.

Hence is a demonstration, there Can be No per=
petuall motion. ffor that must be by successive
working of Equall power's on agt ye other, by Means
of Mechanicall advantage, yt is moving faster then
ye others, or not att all. and If one Moves faster then
the rest, (or Sink lower) ye other's Must goe farther
(or lower) to Reduce that, & so on, whereby the pro=
position of Moving Ever must fail.

Hence also Is demonstrated that all bubles, &
drops in ye air, as also ye Whole Earth & planets
Must be round. for be. a. b. a/n oblong\ drop. ~~that~~ /it\ is
<diagram> prest on all Sides, by ye air alike; If the force
of that pressure reduceth it to a round c.d
the parts ~~a.g. & h.b.~~ at. a. &. b. Must
Move towrds ye Center. e. the space. a g. &
h.B. and ye parts at k. &. f. must goe from
the center, ye Space d.k. &. f.c. but. that
is less then ye other, as a.b. is More then d.c.
and therefore ye parts a. & b. Must Move Swif=
ter, & for yt reason, all pressing ye Same way
have greater power & thrust ye other out till an
equality, that is not but in a perfect sphear.

60v

[page blank]

61r[93]

phisica c.d.

<diagram> Motion.

As the length of y^e Wedg. A. a..
is to the Extream width. B.b. Such
is y^e advantage or disadvantage of
the Instrument.[94] ffor While the Motion
foreward is by y^e line A.a. the block
or cleft open's but y^e width B.b. w^ch is less
and therefore gaines, but an Equilate=
rall wedg get's Nothing, and an obtus=
angled Wedg, throws y^e advantage ag^t
it self. This is Explained usually ano=
ther way, that is by 2. levers meeting
at. a. and Strained at B.b. but that
is Not scientifick, and serves but to Shew
a concordance of truth to it Self. but
of all devices a wedg hath Most of
Rubbing, but Considering by vertue of
that, It hold what it get's, It is the
true benefit had by it. ffor If y^e cleft
be So strong, or y^e Wedg So Slippery that
the Rubbing holds Not, It shall fly out
of y^e Cleft as Shot from an archibuse, for
w^ch reason workmen often put dirt in
with a wedg. And y^e force of blow's, w^ch
are Great & heavy body's put In Motion
and Stopt upon the wedg, Exsuperate as
well strength of y^e wood as the rubbing,
and then holding, y^e wood Will often
clear of its Self. So Much of y^e wedg.

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[93] As the change of header (from 'phisicks' to 'phisica') indicates, this section breaks with the previous folios which ran continuously from f. 7. The next section runs up to f. 79. The first part of the phisica is on narrower, lighter and slightly more transparent paper. Note that we begin here at RN's own alphabetical numbering of c.d.; if this numbering ran aa-az, ba-bz and ca-cz it would indicate an unusually long continuous passage for RN, and even with RN's cavalier attention to the detail of numbering, we must be at about page 60 (i.e., the thirtieth folio) of a continuous series. It cannot be said whether the first part has been accidentally lost, or intentionally discarded, and when or by whom - it may be the result of a BM/BL redaction. All we have to go on is the evidence of re-numbering (see note on f7r).

[94] The earliest instance of the term 'mechanical advantage' noted in the OED is from 1799 (OED, online, checked November 20, 2013); the concept and the term is employed here (see last sentence on f. 61v), indicating RN's much earlier usage. The concept and the term was surely used in engineering circles in this earlier period. Note the expression of the mechanical advantage in terms of the 'walk' at the operating lever relative to the work done at the point where the machine acts.

phisica

Motion.

The last of the comonly denominated
Mechanick powers, is but a perpetu=
all wedg. ffor that gaines litle, and by
reason of the Much Superficies Imployd
holds fast what is got. but there is ad=
oyned to this comonly a /double\ lever, made fast
to y^e stem. as. a.b. on Either side, w^{ch}
<diagram> works it. for Compute y^e walk that
a makes in y^e Same time as y^e weight
riseth, such is y^e advantage of the Con=
trivance so wrought. the Convenience
of this device is, it is applicable to almost
all porposes, with litle Nois & Incumbrance
It is ordinarily Resembled to a Wedg
Rolled about a cilinder: and It is as=
suredly Nothing but Shoving a body up by
a slow declining plane.

It is Needless to Shew how all these powers
may be redoubled & ~~compou~~ combined
one with another to Infinite Increas of
force, If materialls & place (w^{ch} Archi=
medes /also\ wanted) would permitt. All that
can be sayd of them is, that compute
& Compare the walk of the power and
of y^e weight, that is y^e Space Each Moveth
in y^e Same time, & it will be found that
as one is to y^e other, So is the Mechanicall
advantage or disadvantage by the device.

phisica c.f.

Motion

I shall add an Instance or two, to Shew y^e^
universality of these Measures, w^ch^ fall Not
under the ordinary denominated Mecha=
nick powers.

 1. If a drop of water be Suspended
In a free air, It shall Ever be orbi=
cular, and If accident makes it
oblong, It shall /im\mediately collect
Into that ffigure. ffor Every thing in
fluido is found to be Comprest on all sides
(almost) Equally. and If any part of
the Drop Stand out, so that going in
it Shall move ~~less~~ /More\ Space then any other
part shall be thrust out. Such part Shall
yeild to y^e^ Compressure, as y^e^ longest arm of
a lever, and the rest be thrust out. as
for Example, c.A. the drop long, &
c. D. y^e^ Same round. the diameter. C.
A. is longer then. C.D. therefore the ge=
nerall pressure is More operative at
A then at. e. y^e^ Consequence is plaine, &
that a round figure onely, is Equally
Resistant off y^e^ pressure. Wee find this pres=
Sure so considerable that Mercury one
of y^e^ heavyest body's, Not cleaving to Wood
hath Not weight to Resist this pressure In
small parcells, therefore Such are Ever round.

c.g. phisica

Motion.

Water, air, & all liquids Made to pass
thro narrower spaces in ye Same ~~as o=~~
~~ther o~~ time as ye like Quantity passeth
thro Greater, acquires a Swiftness propor=
tionable; and So a slow force, excites
a great swiftness, as at ye shorter arme
of a lever is allwais done. It is pleasant
to observe, an acute-conish-figure made
of lead of ye Shape of an hunting horne
<diagram> dropt with ye Mouth downewards Into
water, the water Shall shoot up as in a
ject'd'eau to a great height. ffor Each=
moment, that yt Enters at ye broad Mouth
(ye pipe being full) must make a discharg
of as Much at ye vent, wch is Impossible
withouth swiftness In proportion. So In all
forces of water, If ye plugg Moves in a
Great vessell very Slow, ye Water Shall
shoot out with speed & violence, as the
vent is Smaller. I know it will be Sayd
<diagram> that these must happen so a
not att all, I grant it, & say ye
lik of every mechanick force What-
ever. And Moreover that as the water
Shoots out With more violence, wch Must
be from ye Caus aforesaid, So Much More
work ly's on ye force that is Imployed
for it. therefore all the water Engeniers

phisica c.h.

Motion

In calculating their force, take an acc^{o}
Not onely ag^{t} what force of altitude
they have to drive, but What Quantity
is to vent, & how fast. Els perhaps the
force they provide Shall Never work their
Engin.

And for the Same Reason Water In any
bulk /or forme\ at the fountaine, Shall Not work
to make the water at y^{e} vent, Rise
any higher then its owne level. ffor if
more water works then just so Much
as Makes a ballance between the height
at y^{e} Spring & at y^{e} vent, It Must pass,
and So create an Extraordinary Swift=
ness, at y^{e} vent. But No More can

Rope Extended. hath an Infinite force
to Sink in the midle some what. and
It is Not an infinite force Can draw
it strait. ffor when it is neer a Strait
<diagram> &, by drawing out at. a. &. b.
continually approximates the
so the Space drawn out in length
at a. &. b. must be More to that of
d. rising, that y^{e} advantage shall Still
be at. d. to Sink, and (to speak geometri=
cally) Infinitely neer the strait. ab. y^{e} point
d. draws downe with Infinite force.

c.l. phisica.

Motion

But above all chimeras that of a per=
petuall motion Shall have p^r^ference
for vanity, and yet it is that w^ch^ Every
beginn~~ing~~/er\ In Mechanicks is possest
with. It needs onely to be say'd to prove
it Impossible, that It must, If att all,
be founded on this project, that Equall
forces by Mechanick advantages, Shall
p^r^vaile, and so In perpetuall successi=
on, with a sort of Rotation, drive one
and other on. then doe but consider
that If Equall p^r^vailes over its Equall
It Must goe farther, & so ~~Every~~ on & on
till In sume, it becomes a downe right
progressive motion, tho Complicated &
perplext sufficiently, and Not a Rotation.

phisica ~~Cm~~

Motion.

Hitherto wee have bin discoursing of Motion as well turning as progressive depending on the Condition of one body; Now we Intend to launch Into More Intricacy, & consider other variety's of body clash= ing, as may happen from the very di= vers modes of them, with Respect to the figures, postures, and other Circumstances. wherein wee shall have the 2. fformer heads of Inquiry. 1. Quantity of force 2. direction.

In order to these the first Matter to be adjusted, is the Condition of touch, Whi= the Manner of that may make any differences. and ffirst I determine that whither It be by a line, or Edg, or su= perficies, Either is Reducible to a point w^{ch} I Shall Call y^{e} point of Contact, and wish it may be Noted as a very materi= all designation of Irregular Impulses. I thinck It will be admitted that a touch by y^{e} midle point of an Edg, or the center of distance In a Superficies, will have y^{e} same Effect (other things agreeing) as if y^{e} touch were by a line or a superficies. ffor that point is the most equall &

Indifferent

B[~?]n. phisica

Motion

Indifferent as to the Extension of the
superficies touching, whereby, If any pro=
montary be In one part, there is the like
opposite, Spread in one Manner or a=
nother to ballance every Consequence
of Either. So If it happens that a touch
is by divers points, or Mixt of lines Su=
perficies & points; those points doe in
tanto[95] Constitute y^e forme or Shape of the
touch as If it were a Continued flatt.
as touching by y^e 3. points of a triangle
is touching by a tryangle.

Then however a touch be, I account it
a point, as really it is on all curve
sided body's, and Conclude there is a
certein plane, w^ch may be Contingent
to the body Struck, In y^e point of Contact.
and No other plane in y^e world Will or
Can touch that point. ffor If it ly in a
Superficies, It is that Superficies exten=
ded, and a Curve can have but one
tangent to a point of y^e Surface. And
the point of Contact, is comon to both
the tangent plane, and y^e surface of
y^e body, w^ch No point (speaking of Curves)
can be but that. This tangent plane
may

[95] i.e., 'in time' from the Italian.

65r

phisica C.o.

Motion

May be considered belonging to Either
body touching, (for more then 2. Can=
not touch on one & ye Same point). but
In ye Moment of the Contact it is Com=
mon to both. And here I have found
some what fixt, whereby to gage other
matters, that seem Not to be reducible
to any rule att all. Therefore I would have
this Notion of the tangent plane (wch
In My scemes will be Represented by a line,
deviding a circle) and is positively deter=
mined In Every touch whatsoever. ffor
tho two body's touch, there Cannot be
more then one Comon plane tangent to
both. so that ye point of Contact is in
this plane, and Comon to both the body's.

Next it will be admitted Impossible for a
body to touch another, but from some
point In the hemisphear without the
tangent plane, whence it is directed
<diagram>[96] Be f.[97] ye point of Contact. A.B
the tangent plane, f may be
touch't from any point in the
hemisphear A.D.B. but Not
from ye oposite hemisphear as from E.
wch is too plaine in Geometry to be here
proved.

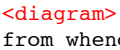
---

[96] All the diagrams in this section have been carefully drawn using a compass. RN usually draws (even his circles) very schematically, and freehand in pencil, before (usually) finishing the diagram with ink.

[97] There is no lower-case 'f' in either this diagram or the similar one overleaf. There is, however, an upper-case 'F', a point on the line AB, and the mid-point of the sphere comprising the two hemispheres (of force and effect, as RN terms them below) - this is 'the point f' discussed in the following passage. RN very rarely uses an upper-case 'F' in his writing, preferring the 'ff' form; he does however consistently (though not exclusively) use upper-case letters in his diagrams. The difference in the formation of the lower and upper case 'f's is minimal and it is mere pedantry which directs me to impose the distinction here. all 'f's in the following episode, lower or higher, refer to the same point of contact being discussed, but simply imitate the letter on the page as closely as possible.

C.p. phisica

Motion.

 The hemisphere A.B.D.
from whence the force Comes
I call the hemisphear of the
force, the opposite that of the
Effect. ffor It will be found
as Impossible, as ye other, that
a body Struck at f. shall have any di=
rection to Move towards any part of ye
hemisphear of ye force; tho In some Ca=
ses of turning It May seem so, but that
will be understood from a particular
caus, And as to all progressive Motion
It holds universally true, that the Stroke
Shall drive ye body /to move\ In the hemisphear
opposite to that from whence ye force Comes.

Next I account that the body struck
must have the Same direction to Move
In the hemisphear of ye Effect, ffrom what
point soever In ye hemisphear of force
the Movent falls. ffor at ye Moment
of ye Stroke, Nothing More is to be found
but opposition of Quantity In that point,
Wch Must be Reconciled by parting again.
and ye point once designed for the stroke
all the Consequences are determined
but what proceed from More or less force.

phisica cq.

Motion.

There is Neither drawing, Shoving, Nor
Sticking In y^e Contact, for a point ad=
mitts No such differences, No Nor line
nor plane If y^e parting be Not obstruc=
ted. therefore If the body at f. upon
a stroke from D. (for Instance) be de=
termined to Move to. E. It shall have
y^e Same direction, tho y^e Stroke Came from
C. or any other.

The direction of the force from D. w^ch
is the rectangled diameter of the Same
hemisphears, and Shall be Called the
axis of the force, hath the greatest
power of any. and It is Not possible
that a direction from any other point
In y^e hemisphear Should Carry so Much
force at the Contact f. as from that.
ffor the understanding w^ch, and other
other matter's thatt will depend on it, wee
must Consider, that the touch upon y^e
point f. is y^e Same, as if the body Struck
were Extended In Infinitum from the
tangent plane. A.B. So as wee Must
look upon the tangent plane, to be as
It were the body to be Struck. then will
here result a double velocity, one

absolute

66v

C.r. phisica

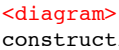
Motion

Absolute, and y^e^ other of approach,
the absolute velocity is [Exponed?] by
the semidiameter of y^e^ hemisphere
Representing y^e^ direction of it, and is
supposed allwais y^e^ Same, but the ve=
locity of approach is less as the Incli=
nation of the direction is Inclined to
the plane. ffor from C. w^ch^ is distant
from y^e^ plane. A.B. but c.g. = G.F.
In Moving the radius c.f. = D.F. tou=
cheth. but from D. Every degree of the
velocity , is a degree of y^e^ approach, and
is coincident. therefore from D. the ap=
proach is with Greatest force.

It is also Considerable, that the tendency
of the stroke at f. is to Move f. from that
place. and is No otherwise the If wee
Should suppose the whole Hemisphear
A.D.B. to strike y^e^ other A.E.B. So that
If nothing /on y^e^ part of y^e^ body struck\ altered, but the tendency of y^e^
force p^r^vailed, f. would move in a direc=
tion continued In y^e^ axis D.f. ~~Now it~~
~~Requires a greater~~ /now a less\ velocity /In. f. so passing\ will answer
the force from c. then from. D. by so
Much as C. approaches slower then D.
for to make way for. D. Requires all
but c. but a /velocity\ proportionable to y^t^ of y^e^ access

phisica c.s.

Motion.

 Then It will appear from the
construction of this sceme, that
The force of the stroke
deminisheth, In the propor=
tion of the Sines of the In=
clination to the tangent
plane. So that.

As the velocity absolute. C.f = D.F.
Is to the velocity of approach. C.g. = G.f
so is the radius. D.f. = C.F.
to the sine of the Inclination. C.g.= G.f.
whereby If the rdius f.d. were marked
as a line of sines, It gives the Increas of
force rising from /f.D.\ y^{e} tangent plane, ~~With~~.
Where it is None, to /fD.\ the axis where it is
greatest as from. D.

This is one of y^{e} mean's of deminution
of y^{e} Stroke, there May be another, w^{ch} is
from y^{e} figure of the body, and the mode
of its falling upon. f w^{ch} May be with
more or less force, as those matter's happen.
but I Shall postpone that till I have Con=
sidered y^{e} body struck, w^{ch} will Reflect
an Explanation on it. but In y^{e} Meantime
I may call one y^{e} deminution of place &
y^{e} other deminution by posture.

c.t. phisica

Motion.

Now as to the direction of the body Movent
after the Stroke, It depends partly on the
Inclination, partly on y^e^ opposition at F.
and partly from the figure & manner of
striking; this latter I shall postpone for
y^e^ Same reason; therefore at p^r^sent I shall
Suppose the stroke to be made Regularly
and direct as with a Globe or side of a
cube. &c. but a Globe is the most Natu=
rall to suppose. If there were No Inclina[=?]
tion from y^e^ axis, It is certein It must Goe
or Come in that line & No other, but
being Inclined as at. C. It will goe in
some other direction. and whatever
that may be Supposing the ~~direction at~~
resistance at f. to be Infinite, yet sup=
posing any degrees of yeilding at. f.
they will be seen In the angle A.f.H.
w^ch^ distinguishes the direction after the
stroke from what had bin If No oppo=
sition had bin at [~~.~~?]. f.

Many thing's are best judged by their
Extream's, and this case as I take it May
be so. ffor first grant the opposition
at f. to be Infinite, or whose Compari=
son is too wide ro be accounted. then two
thing's ffollow, vis^t^. 1. that the velocity
of

phisica c.u.

Motion.

/of\ the Movent is No whitt abated, ffor
the rule of a less falling upon one
Infinitely great Refects with all its
fforce. 2. It shall goe from the tangent
of Impuls, with the Same Speed as it
approach't; w^ch two thing's Cannot
happen In any direction then Such as
makes the angle of Reflection from the
tangent plane Equall to y^e angle of
the Incidence upon it. that is. ang. C.g.F.
= H.F.B. that is In short, the velocity
absolute, and y^e velocity of departure
shall be after the stroke, the same as
the absolute, & approaching velocitys
were before it.

This celebrated proportion meets with
a different proof, ffor they Comonly
observe that y^e point c. is Compound
of two motion's from C. to G. and from
c. to g. In y^e Same time, w^ch Carry's it
In a diagonall to F. where onely y^e
part c.g. is stopt, y^e other remaines.
&c. but I have Quarrelled that Supposall
already, and Cannot allow it In this
Instance. ffor Supposalls of path's are
arbitrary & Infinite, however If it agrees
with

with others, I dispute Not; but take oc=
casion to Say once more that truth May
be proved Severall way's, and of all that
is y^e best y^t is drawne from y^e nature of the
thing. but one thing I must take Notice
of w^{ch} is that None have Stricktly defined
the plane that these angles are made
with universally as here is done, In the
tangent of y^e force. And it agrees with
the comon Instances of Reflections, of
balls, light &c.

But to proceed, It may be demanded
what shall be y^e Result of yeilding at
f. and by what degrees, to appear in
lessening the angle. H.F.K. I must
for answer (I might say guess, ffor I
doe Not undertake such abstruse
Calculates as here might be Made) Re=
sort to Equality, & first see the effect of
that. therefore suppose the Magni=
tude at. F. to be such as hath thereby
a force exactly to that of C. falling
upon it all things considered, then I
say. C. Shall Not Reflect at all, for that
Requires a superior force, but it Shall
Move In y^e very tangent. A.B. being

neither

phisica Cy

Motion.

Neither raised Nor depressed; but goeth
one with a force of velocity. equall to
D.G. ffor so Much force as the Inclina=
tion made Ineffectuall Remaines untoucht.
Then If the Resistance Grows still wea=
ker at. F. the direction Shall fall be=
low, or without the tangent A.B. as
for Instance to M. and then it is Called
Refraction; and is More or less deminisht
under an Exact Equality to y^{e} Movent
force at K. So here wee have the rules of
Reflection & Refraction defined by the
tangent of y^{e} force, and the resistance
at the point of Contact. If that throws y^{e}
body back Into the hemisphere of y^{e} force
It is called Reflection, If it be so litle as to
lett it into the hemisphere of y^{e} Effect it
is called Refraction, and both are ordered
after the plaine and clear rules of Impuls
of one body on another. It Must Not be Won=
dred y^{t} wee say No ang^{o} of Reflection Can
be Exactly Equall to y^{e} ang of Incidenes
becaus the opposition w^{ch} Wee Call Infi=
nite is Not so, but onely very disproportionat

as

69v

c.z. phisica

Motion

as a childs marble to y^e Globe of Earth
w^ch cannot be sayd to be Nothing, No
More then y^e Motion given y^t Globe of y^e
Earth by it, or the defect of Equality
In y^e ang. of Reflection, all w^ch, are tanto[98]
however small.
<diagram>

[98] i.e., 'something'.

phisica. D.a.

Motion.

Having done at p^r^sent with the occ=
urrences of the body striking, I come
next to consider, the case of the body
struck at y^e^ point of Contact, f.[99] W^ch^
Will plunge us In yet More Intricacy.

It Must be Remembred that w^ch^ I hin=
ted of the Inclination of the Impuls,
as Not altering the direction of the body
Struck. as If f. upon a stroke from D.
should be determined to Move to. E.
It Shall have the same direction ~~as~~
If y^e^ force came from C. or any other
point in the hemisphear of the force.
for 1. a Contact upon the same point
cannot be varyed but In More or less
of force, and all that can be thought
or sayd of protrusion In the Contact
(w^ch^ is but an Instant without /any\ Resting)
is Equally true from all parts. then
2. It will appear by what ffollows
that the direction of a body struck
is formed by the Condition of the Movent
and Not of that struck. In order to
clear w^ch^, I propose

first that the force Imprest upon
the severall part's of a body must

[99] Change of pen. Here we can note (evidenced by the change of pen in the penultimate line of the first paragraph) that RN had already written the headers and numbering before starting on the text.

D.b. phisica

Motion

pass from the Contact by strait lines
Every way. as If it were asked how the
<diagram> points G. & f. were Influen=
ced by a stroke at. E. It Must
be answered according to the
right lines E.f. &. E.G. And If the body
should happen to be annular or hol=
low, the case as to the Influence of the
stroke directed to and among the pa[rts?]
is the same as if it were Solid, as Sup=
pose the body D. to be hollow. It Must
be granted that G. Is Influenced as if
y^{e} force fell upon it by a right line from
E. thro y^{t} hollow. this the Consequence
of a perpetuall union of Matter, In
Continued body's, that whither y^{e} parts
hold together directly in the line of
the parts struck, or laterally, When one
is Moved all the rest are Inclined or
tend to move from the force, W^{ch} is at
the Contact. And the Nature of force
Speak's the same thing, ffor what is
that but a Consequence of the Im=
penetrability, w^{ch} In two body Coming
together cannot consist without al=
teration /and\ that Cannot be other then par=
ting again.

phisica. D.b.

Motion.

Againe. Besides Consider the parts of
Every body are to be accounted Small
to Infinite, and then that they are
regularly formed as in Cubes. &c. as
you pleas. then take any particle &
conceiv it Influenced from ye Stroke
<diagram> as c. or. D. and Imagin lines
from ye contact f. to the Ex=
tream's of the surface of those
particles obverted to the force
and from ye Sceme it is plain
that the particles must Move on by
D. &. c. as if struck by a line directed
from ye point /of Contact to ye Medium point of\ ~~to~~ that obverted surface
and the direction of the Influence on
the parts is f.d. & f.c. So of the
rest & More Exquisite as the devisi=
on is Infinite, whereof the Sume or
comon conclusion is, that the ten=
dency of Every particle of a body
struck is to Move in a right line
from the point of Contact, and that
If free, they would actually doe so.

Another observation is that, No part
of a body struck Can directly tend
or move to any region without the
hemisphere of the Effect. And this gives
us

D.d. phisica

Motion.

us the different Manner of force Wor=
king on a body Struck, as it May be
formed. that is. 1. driving. 2. drawing.
That w^{ch} wee discours of ordinarily
is onely the driving Manner, and
drawing is Not to be understood at
all, without it be Expressly stated. As
here, the Influence of the stroke is to
<diagram> caus a separation of the
body's at the Contact f.
and the tangent of the force
A.B. is Comon to. both, so
that to part, is for the bo=
dy struck to Remove from
the tangent Into y^{e} hemisphear of the
Effect. for If it Should Remove Into the
hemisphear of force, It goes against
& Not from the force. Wherefore Every
part of the body E. tends to Move tow[=?]
ards some point in the hemisphere. E.
and No part Into y^{e} hemisphear. F. but
If a Body D. were Joyned as one to E.
and lay In the hemisphear of y^{e} force
I say. D. had No tendency at all from
the stroke, but is all Impediment and
is drawne by y^{e} part to w^{ch} it is annex=
ed, and is So Much detension and Nothing
els.

phisica. D.e.

Motion.

Els. The consequence whereof is, to
divert the direction of. E. as also the
Speed it would have, from the stroke,
after y^e Measure & place of it; but hath
No Share of the tendency. the rather
becaus If D. lay contiguous but loos,
& f. were a stroke on. E. (Not turning
it) all parts of E. would be Moved
but No part of. D. therefore that /being loos\ is
Not concerned but /being fixt\ as Impedim't /onely\ and,
consequentially; and clasheth Not with
our conclusion's, tho for clearness wee
Shall yet Suppose all force driving &
Not at all drawing.

Then it is to be Considered that the
direction of every body struck, is by a
line (or the path of y^e Center) w^ch on
a strickt Calcul shall fall out to be
a medium of the direction of all the
parts; ffor All the parts tending by
right lines from y^e point of Contact
the whole must have a tendency
Compound of them all. ffor Every
whole is Compound of its parts. And
This line I take to be universally
determined from the point of contact
thro the center of the body. I doe Not

here

D.f. phisica
Motion.

here, More then Elswhere p^r^tend to Make
a Calcul, It is y^e^ work of Geometers, &
such Indeed y^t^ study & practis litle Els.
I must Content My Self with a phisicall
way of Guessing, & Should be glad to
have No More reason to doubt of any
point then this. But In Regular the
<diagram> case will readily be demon=
Strated, Such as strokes upon
Globes, or the diameters of
cubes Ovalls, parallelipipedons
and y^e^ like. ffor there is just as
much drawing from y^e^ Contact
one way as y^e^ other, towards A. as tow=
ards B. therefore the whole Must be di=
rected In a Medium Equally taken be=
tween both as. to. E. w^ch^ is continued
from y^e^ contact thro the center, as was
observed. And I shall once More Repeat
that whatever the forme of a body
be, whither upon the Stroke it turnes
or Not the direction of the progressive
Motion of it, Shall /be\ by such line.

And In order to Investigate the Con=
sequences of the variation's I am a=
bout to Consider, I determine of one
sort of Impuls, upon a Conick

or

or piramidall forme, being Isoceles.
<diagram> and acute angled. let e.c. be
the axis. D. yᵉ Center; and AB
the tangent plane at axis-
extreme point. f. a stroke u=
pon E. I say the direction of
this body shall be by the
line E.C. ffor being as is
Stated Every way uniforme
& yᵉ Impuls Indifferent, as a Globe or
cube &c. It must Move So Without tur=
ning.

Then let us Imagin the Whole hemis=
phear devided Into Infinite pyramidall
body's whose Cusps all meet in one
comon point the point of Contact f.
<diagram> such as. a.b.c. &c and an
Infinite /force\ fell fell on the
comon cusp of all those
pyramids, I say they Should
Every one move, In a direc=
tion by their centers from
the contact, as f.a.: f.b.: f.c. &c.
So that If one /con\templates the Influence
of this Stroke on the Infinite piramidall
body's, that is on the whole body struck
It is as perpetuall Ray's alike proceeding
every

D.h. phisica

Motion.

Way throout the whole hemisphere of
the Effect. It is Not a Novelty In specu=
lations of this Nature, to Imagine Infi=
nite devisions of matter, Especially with
Geometers, all whose demonstration's
of curve spaces depend on it. I am sure
I am neerer truth then they /ffor I take the conclusion in finite parts to be true &\
~~ffor~~ I Ima=
gin /but\ what really Is /subsisting that is\ the Substance ~~Infini~~ /very Infinitely\
~~taly~~ devided, they Imagine what is Not
a circumscribed, as well as an Inscribed
figure, and by fluxing them Into a
coalescence, finish their argument.

In the Next place I observe that alltho
<diagram> all the body start's in ray's
from the force yet it is Not
with Equall force In all parts
of the hemisphear; the diffe=
rence depends on the Same
argument as served for the
deminution of force, by the
Inclination of the Movent to the tangent.
ffor Supposing an Infinite force at. f. It is
certein the body e. that ly's in the Axis
of the hemisphere, must move away
with y^e whole velocity of the movent,
ffor that is Required (aS I have often Noted)

to Reconcile with the force, but the
body's a. b. c. d. may Reconcile
or answer ye Way of ye force, with less
velocity, & less, as they ly Inclined
to the tangent, and at length neer
B. the velocity of the Motion will be
litle or Nothing. I mean here onely
what is progressive, upon ye Supposall
of a Strok upon ye extremity of ye axis
of Each pyramid; when is No turning
as was before Shewed. Wee Must Sup=
pose that ye Motion of ye point f. is
ye Same as If ye whole tangent or he=
misphere A.B. struck. and contract by
force into ye point of Contact, for free=
dome, In wch ye part's may be Supposed
to Move according to the Exigence of ye
force; And that is, however wee May Sup=
pose ye force Infinite or directed, or Re=
prsented by ye whole hemisphere A.B.
Contracted at f. to drive the obstacle
to. E. the axis of the other hemisphere
of ye Effect. So taking the Extremes, at
fB. there is No protrusions att all. for
the point F. can pass away without
deturbing the other points in ye line A.B.

But at

D.k. phisica

Motion.

But at. E. the axis, Nothing less then
the full velocity of the stroke, serves
to Make way for y^e point. f. In w^ch
all the force is contracted; therefore it
is Necessary that as the direction of
the piramids open from y^e axis, that
is Make More way ~~with less velocity~~ /as they are from their\
position determined to Move, so in
the severall degrees from all, (pt^s. fe.)
to Nought (by f.B) the /less\ velocity
of their Movement answers or Re=
conciles with y^e force that drives them.
<diagram> as for Instance suppose a
particle of body at h. & one
at b. and by the stroke at
f. upon y^e whole Hemis=
phear of pyramids, those
particules were Influenced to Move. I
say as the Elongation of B. vis^t . H.b.
is to the the prime force. F.E. so shall the
velocity at b. be less then that at H.
or E, or any other point in y^e axis,
as also towards B. In any point of
the Ray f.B. ad Infinitum, one way
and contracted Into y^e very point of the

phisica. ~~B~~D.l.

Motion

contact y^e^ other way. Whereby that is
conceived done in the point of Contact
vis^t^. the distribution of the velocity of y^e^
Stroke among the parts of the Quantity
struck, as would be done In like Incli=
nation, to Infinite distance. And take
it thus. In the direction F.H. the body is
never out of the forces way, but as full
velocity, by direct movem^t^ carry's it
but by f.B. the body In Moving from
f to b. is departed from y^e^ way of the
force. by the space. H.b. that is the
sine of the departure of the direction
from f.E. as that departure Increaseth
the velocity of the tendency or Motion
deminisheth then wee Must say, of Each
of these piramidall body's, or parti=
cule of matter In that hemisphear,

As the velocity of y^e^ Stroke, Expo=
ned by y^e^ Radius fc. = fB.
Is to the velocity after y^e^ stroke
y^e^ vers sine d.b. = fH.[100]

As the radius (exponing y^e^ whole
velocity of the stroke). fE. = f.B.
is to the ~~velocity of~~ /sine of the angle of departure of\ any pyramid
or particle (exponed) F.b. = f.[8?].[101]
so is the velocity at y^e^ Stroke f.B. to
that of y^e^ pyramid a particle after it, if. [8?].

---

[100] The shaded area is crossed out by diagonal lines.

[101] I transcribe this figure as an '8'; there is a point on the diagram on f. 74v (to which RN is referring) labelled (as I read it ...) '8'.

D.l. phisica.

Motion.

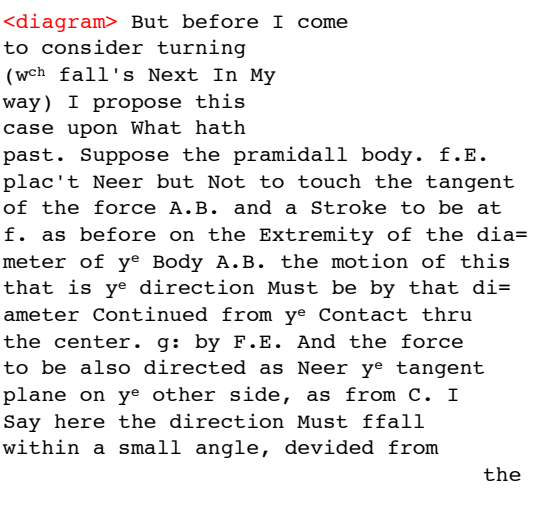
So If the radius, f.B. from B. /be\ devided
as a line of sines, those sines will ex=
pone the degrees of departure, and /consequently\ de=
minution of velocity, as beginning at
Nothing in ye direction f.B. and Increa
sing to ye utmost In f.E.

It is Remarkable to observe, how the
degrees of deminution of velocity In
the Hemisphear of ye Effect, answers the
deminution of force in the hemisphere
of the force, ffor both are Exprest by ye
Radius Marked as a line of sines. [~~...~~?]=
~~ly Reverst, for the shrinking of ye force~~
~~ye devision~~ beginns at ye Center, /[~~circumference~~?] ~~& Ending at~~\ ~~and~~
~~of the velocity exerted~~, /and ending at ye Circumference\ ~~at the circumfe=~~
~~rence~~. as from ~~Ð~~ /f\ to /~~£~~\ D. for ye Inclination
of ye Movent & from. B. to f. that of the
Moved. for In both the force at A. & the
velocity at B. are Nothing, but at D. &
E. both Absolute. So as the Inclination
from D. ~~towards.~~ (. of the force in that
hemisphere /towards C.\) shrinks ye force, & is Marked
on the radius from f. to D. deminishing
so the depature from E (of the velocity
Impres't in that Hemisphear) towards
[B?]. Shrink's the velocity, and is Marked
in ye radius f.[D?]. deminishing. What is
More reasonable, then that What Incli=
nation in one hemisphear deminisheth
the

phisica. Dm.

Motion.

the force, In the opposite hemisphear
should have like Influence In ye Effect.
ffor on one Side, the body Moving
being Inclined, becomes as If the Quan=
tity shrank, so on the other side ye
body Moved, should become as If the
Quantity Increased. But these are I
fear but jargon, so I proceed.



<diagram> But before I come
to consider turning
(wch fall's Next In My
way) I propose this
case upon What hath
past. Suppose the pramidall body. f.E.
plac't Neer but Not to touch the tangent
of the force A.B. and a Stroke to be at
f. as before on the Extremity of the dia=
meter of ye Body A.B. the motion of this
that is ye direction Must be by that di=
ameter Continued from ye Contact thru
the center. g: by F.E. And the force
to be also directed as Neer ye tangent
plane on ye other side, as from C. I
Say here the direction Must ffall
within a small angle, devided from

the

Dn. phisica.

Motion.

the direction of the force, and Seem's
as if it were an Effect contrary to y^e^
tendency of the caus. w^ch^ in practis,
as the case of Sayling by, (as seamen
terme it.) that is, In a cours Neerly
opposite to y^e^ wind (and is from hence)
seem's very misterious, but is by these
consequences of y^e^ comon laws of force
of body upon /body\ clashing ~~is~~ universally
true, is explained, & made appear rea=
sonable. ffor suppose the Shipp, (as May
<diagram> be Reduced) to be as
the severall body's Com=
pounded. C.D. and y^e^
Wind from E. falling
with paralell direction
E.f. upon the severall part's of it,
and those by our law's directed, towards
c[;?] It is plaine the ship must goe towards
C.[|?] against y^e^ Wind: but If y^e^ Wind also fall
on the part H. It then, by like laws
directs it also towards K. so the Cours
will be mixt of the direction H.K. and
f.c. & thereby fall towards M. w^ch^ is
that the seamen Call leeward Way
and is Ever observed to happen More
or less in Sailing by. The rest of this Case

phisica D.o.

Motion

May readyly be Suplyed by the Imagi=
nation. allowing for all circumstances
of forme of y^e^ vessel, resistance of y^e^ Water
and position of y^e^ Mast's & sailes. of w^ch^
pardie's hath Made a Most Intricall
work, and It doth Not appear to Me
that the matter is at all understood
from what he say's.

There is one Grand Corolary from all
I have Sayd hitherto, w^ch^ is that upon
Every possible clashing of body's, If one
by Moving Never so litle May Make any
way for the other to pass, It Shall Move
but so Much slower, as the way Making
is faster. ffor the tendency of a stroke
spreads Every way In the hemisphere /of effect\ but /not\
Into y^e^ very tangent or diameter /of it\ so
The force is Some what /coming\ from ~~Every~~ /any\ part
of th~~at~~/e\ hemisphere /of y^e^ force\ but /nothing\ In y^e^ very tan=
gent /or diameter\ and If the one and other body be
so plac't as not to be In the very tangent
there will be effect on Each other, but
More languid as the approach or Neer=
ness to y^e^ tangent is More or less; w^ch^ is
the /very\ thing I have p^r^sented, & will appear
to be the caus of Infinite practick occur=
rences In y^e^ World. as In place I may Intimate.

D.p. phisica

Motion.

 Now to Come to the rea=
son of turning, (having as
yet, avoid stating body's
so as must occasion it,)
wee must Retain In me=
mory, o^{r} former sceme,
of the too hemispheers, the
Tangent plane, the force
to come from any part as, D. the stroke
on f. dispersing ray's of velocity thro=
out y^{e} hemisphere, more Swift neer y^{e}
axis of y^{e} hemisphears, and less Neer y^{e}
tangent of y^{e} force, In the proportion of
Sines, of the angle of departure from y^{e}
Axis. I say having this Condition of the
case in our mind, [as?] May be had u=
pon Every Impuls on body whatsoe=
ver, wee may determine of the Success
however other Circumstances vary.
as Suppose y^{e} body Struck at f. to be
Regularly or Irregularly formed or pla=
ced. as Gloes. f.H. paralellipipe=
don's as p.H. trapeze. as A.H. or
tryangule, K.[A?]N. that is solids re=
p^{r}sented under these plaine figures.

ffor

phisica. Dq.

Motion.

for What place in the hemisphere the
part's of the body struck possess, they are
Influenced accordingly Some to Start
one way and Some another, and with
various Celerity's, as the rules Require,
So Much Insisted on; as for y^e^ Regular
& uniforme body's p.H. and K.N.
they have bin spoke of, as ballanc't
by their part's w^ch^ draw with Equall
force, towards K. & towards. H. So Nei=
ther In any Respect p^r^vaile, & the di=
rection shall be f.E. the medium, &
with force, as y^e^ Rules of Impulses, of W^ch^
these were y^e^ Supposed Circumstances [Require?].
But among other figures one May Ima=
gin to posses room In the hemisphear
I Shall Single out y^e^ triangular figure A.
K. N. to discours of. And it being plain
that the parts M.N. are In place to
have a swifter Motion the the parts
f.K. or at least, If a part of f.K.
as. S.M. be equally Inclined with. NM.
yet the Rest K.p.M. have More that
have Not Such Swiftness Impres't. as
at p.K. and those must In conse

quence

[102] This page has received treatment, presumably for a tear, which runs vertically from the top.

D.r. phisica.

Motion.

 ~~Must~~ Move Slower then
those on y^e^ other side or
neerer the axis. w^ch^ of
Necessity make the body
turne around. and there is
no mean's of making
a body turne, but a Stroke
Influencing the parts with these une=
quall tendency's. If wee appeal to the
extream's, wee shall have great guess
at the measure of turning, Compared
with the progressive. ffor a body perfec=
tly uniforme, & struck on a direct dia=
meter, as S.M.N. Whose line of Mo=
tion or y^e^ direction of it, is Coincident
with y^e^ axis, or Greatest force. f.E. Shall
move onely progressive, & Not turne at
all. but If y^e^ body were formed as here
 s.K. and the Stroke fell upon
the point Next to the Extre=
mity of y^e^ diameter, A.f. that
is or. f. this body Should turn
upon its center, and Not move
progressively att all. but In
observing this Case, wee Must
have a caution Not to Suppose the
Stroke on y^e^ very End of y^e^ diameter f
A. for then it becomes a Regular and
direct Impuls.

phisica. Bs.

Motion.

It is Not amiss to Remember a puerile
Experim^{t} or rather play, with a bat=
toon, and a Romboid peice of wood
they Call a Catt. If the stroke falls on
the shortest diameter. S.K. It fly's a=
way Swift with No turning. but If it
be Struck at the Extremity, It shall
Spin very much & Swift, but as to
y^{e} flying away the Stroke is lost. And
as y^{e} Stroke falls on the Intermediate
points More, or less, So the turning is
More or less Refract from the direct
Impetus of the battoon. I doe Not know
that a More Nice Experiment would
disclose the Generall tendency of these
Irregular Impulses, then this, that ffew
Men are Strangers too.

Then If it be the Moments of subs=
tance and their position In the hemis=
phear, w^{ch} distributes the force of the
Stroke by turning & progressive Mo=
tions, what have wee more to Say
then that a point Indifferent to y^{e}
Substance Shall (as Before was urged)
be y^{e} center of the motion. and a me=
dium or adequate proportion take

place

place between the turning & progression.
That is the degrees of Inclination of
the line passing from the Contact to
the center of the body's force. and the
right sine of it? That that line is y^e
progression of y^e center I held before,
Now I must upon the Same termes of
Guessing, hold that the force of turning
on the body and the progression toge=
ther, are Equall to y^e force of the Impuls.
and as the sine of y^e angle of departure
is to the whole radius, so Is the turning force to
the whole force of y^e Stroke, and substract
the force of the turning from y^e whole, y^t
is the sine of y^e departure from the ra=
dius. and the residue of y^e force, exponed
by the residue of y^e radius is the force of
the progression.

I must Repeat that I am a Naturalist
& Not a geometer, and these conside=
ration's of solids & their passion's are
Matter of most abstruse demonstration,
therefore I leav the Calcules to such as
are capable & delight in them. and
most Readily Should Imbrace, a disco=
very that I argue fals, desiring onely to
know and Impart what is true.

80r[103]

(G) Comentations.

A par.[104] 1. Angells| the distinction of Cartesius by
cogitation and Imagination is unintelligible,
for wee can have no knowledg of any thing but
throw some Sensible Images, and pure abstrac=
tion is a declared Ignorance, as when wee
say cogitation without sensation, wee mean
nothing. and Referring to Angells or spirits
doth not help, for as to us their Essence is a meer ne=
gation, and what wee p^r^sume of their way of
thinking is but similitudinary with what wee
perceiv of our selves w^ch^ is p^r^carious & vain.
The Error lyes In the misapplication of the
word, think, w^ch^ with us is Imagination or
nothing, wee continue in thinking that is in
~~continuance of~~ time but with angells or meer
Spirits, perhaps there is No time at all, w^ch^ may
be further hinted Afterwards, It is Enough at
p^r^sent that the word cogitation in abstracto
Is not allowed in these discourses to signifye any
thing.

par. 1. B ... mixture &c. (1) This is Not Intended &c.
2. C _ _ Brutes &c.
3. ~~C~~_D__ Instinct &c. (6?) ~~this is Not Intended. &c~~
[~~...~~?]
____ ~~7~~. D E... W^ch^ facultys, &c. I have conjugated these two
facultys, sensation and memory, as necessarily
con=

---

[103] The rest of the volume consists of full-width sheets of generally heavy, opaque paper. In pencil at the top of this page the capital letter 'G' is inscribed, encircled, in pencil. From here to f. 91v the handwriting appears very similar to other handwriting examples from RN's old age (i.e., post 1730). So these next fragments are possibly a quite late texts.

[104] For the next dozen folios (also up to 91v) RN uses a wide LH margin (the wide LH margin is also found below, for example from f. 165r-175v, and from f. 240r to the end of the volume).

phisica

consorting in all animall judgm^{t} of
things, for without a sensation nothing
is perceived or known, and without compari=
son ~~of one with other~~, as of p^{r}sent with things
past, and of those one with another, w^{ch} /is\ y^{e} office
of memoriall Reflection, Nothing is judged, And such
transitions give life to y^{e} Animall, ~~for~~ |~~from &c.~~
there hath. &c.

5. f Idea, notes fol 7.

5. ~~8~~: G. Attention - &c. (8)
7. H Are called p^{r}judices; (10).
8. I. Exotick experim^{ts} (13)
9. K. This paragraff perhaps may meet with
more Reprehension then any other In the
heap that lyes afore us; ffor It Intimates
that y^{e} phisicall science, mostly thought to
be vain and Incertein hath a firmer fown=
dation of truth then any other science w^{t}ever
That is made good by shewing that it affirmes
nothing but what truly Exists or must happen.
and allows of No principles that are Not truely
what wee take them to be, nor consequences that
may or may not Succed, but that all things natu=
rally are certein; and what Incerteintyes are

obs=

phisica

observable they must be ascribed to our fond
and Erroneous thinking, w^ch^ to Correct, and to bring
our opinions to y^e^ truth of things is y^e^ work of Na=
turall philosofy. What are the ordinary scien=
ces in y^e^ world but so many Conjecturalls, &
most depending on free will; and Such as have
no Indubitate principles, whereupon to Relye;
And mathematicks, w^ch^ are a branch of Naturall
philosofye, deal onely In measure, and that Supposi=
titions, there being no real thing existent in y^e^ world to
answer what is p^r^sumed. What shall wee say to one (& he
a mathematitian) /who affirmes\ that all his Complex Events may
proceed from pulsion, attraction, or other power un=
known, and Still his demonstrations stand firme? But
here is ~~but~~ /onely\ one principle asserted and that/universall and\ Infallible.
And If what wee know /is or may be\ truely Existent, with a Mathe=
matically Liberty, wee Suppose Such to be, definitely, It is
not /wholly\ Conjecturall, becaus the subject or principle is found to
be universall, Exclusive of all quallitys, besides what is Com=
prehended in y^e^ Essence of it. And Such being y^e^ founda=
tion of phisiologys, I have Reason to value y^e^ science
as superior in certinty to all others, provided it be Con=
ducted with a right Judgm^t^ denuded of /all\ Either vulgar
or artificiall p^r^judices whatsover.

81v

L. 12. After 75. a Coment or apology.

phisica.

fol. 103
par 53.[105] The case is reduced to meer length) the
doctrine of Mechanicall power's hath not bin
clearly Enough unfolded, whereby the true
caus of such surprising Effects, for w^ch^ Cartesius
was Much at a loss. Might be manifest to Com=
mon sence; therefore I shall make such addition
of Notes here as may Conduce to that End. The
foundation of all is, that as Space, so force is com=
parative /and\ admitts of all degrees of More & less;
The spaces, by Extension; & force, by effects. And
those are y^e^ alterations of distances, & aspects u=
pon Impulses, when bodys occur, and separate.
These matters have bin set forth In particulars;
w^ch^ may serve to authorize our Expression's w^ch^
must be such as are usuall in Mechanick discour=
ses, Such as force, Resistance, Excite, direct ob=
lique, & some others, without further Explana=
tion then hath bin already given. And first to
consider the state of a Single body and the
difference of the force of it between direct
progression, and turning without progression.
and the consequences of such difference. ffirst
It is allowed, that velocity added or detrac/t\ed
to or from any moving body, Increaseth or
Lessens its force, and there is No difference be=
tween Equall magnitudes, as to force directly

[105] This heading, or page numbering, is in the margin.

phisica 104[106]

But velocity, for w^ch reason our discourse will
fall cheifly upon that

If any body Impells another, it strikes
with Equall force whither be by an ar=
cuate or Rectilinear progression by the
tangent at y^e point of Impuls.

<diagram>[107] As Let y^e Impuls be at D. whither it Comes
by C.D the arch of a Circle, or by A.D. the
the tangent at D. the Motive Effect upon the
Impelled B. will be y^e very same, ffor at the poin[t?]
D. the strait line and the Arch become one and
the Same, and cannot be devided between Rec=
tilinear and Arcuate.

If a cilindricall body Impells ano=
ther, by, the Extremity of any diameter,
while it turnes upon the axis, It is with
the whole force that in such action May
be ascribed to that body, So Impellent.

ffor the utmost Swiftness is there, and all the Sub=
stance acts. And such an Impuls is subject to y^e
rules of plain Impulses, and y^e force may be
Gaged by y^e magnitude of y^e Impelled, for it
may be such as by its Equallity Shall Stop the
turning, or by more reflect it; but if less the
utmost

---

[106] This appears to be a page number following on from that in the marginalium on the previous page. There was no numbering on any preceding pages (although there were marginal page references), but there are some 'numbered pages' below (*see* f. 86r ff).

[107] This diagram has been cut from another sheet of paper and very neatly pasted into the margin after the text had been written (it overlaps the text at one point). All the diagrams in this section (i.e., as far as f. 91), including this one, have been drawn directly in ink, mostly using compass and straight-edge, and have sometimes been smudged in the employment of those tools.

phisica.

utmost Energy's is to produce an Equall ve=
locity, altho Much More minutely opposed.

The force of y^e Cillinder progressive is
Greater then y^e former by one fourth[108] part

That is the Magnitude, which will Stop the
Turning, being quadrup-/-led\ will stop the whole Mo=
ving progressively, and Neither more nor less, but
will have just that Effect

<diagram> W^ch Seems to be thus demonstrated. Let /AFC\ be the /[centrate?]\
diameter plane or transvers Section of a solid
cilinder turning In y^e order A.F.E. with ~~any~~ /a\
~~velocity~~ /force Irrisistable\, and let A.B.= to y^e perifery. that is to
AE. x [(ferez?)] Let infinite cocentricks, g.h.s. be
described and of each the periferys layd downe pa=
ralell. as ad: b.e: f.c: ~~I say that all shall ter=~~ /~~so that A.B. =~~ And then \
~~minate in y^e diagonall C.B. for a body at~~ a /~~let A. [.?} turn with any velocity~~, a
body Impelled at [A on exertion turns?]
~~struck with a superior force, but with a velo=~~ /will describe y^e line AB. and y^e same
body, at [.?] y^e line\
~~city of y^e perifery a.g. of w^eh the diameter~~ /a.b. and at b & bE. and at c:c.e. and all
y^e Rest so\
~~is to y^e diameter of y^e whole A.E, as [I. to ..?]~~ /that Every velocity shall terminate
on y^e diagonall BC[109]

A.f.E. a /transvers\ Section of a ~~turning Cli~~ Cilinder
~~by y^e at~~ /by\ y^e center. and turning upon the
axis C. with a force Irresistable, but velocity
Exposed by y^e /tangent\ line A.B. w^ch is Equall to the
perefery A.f.E. /I say\ a body Struck directly at /the Extream point\ A.
will arrive at B. in one Revolve of y^e cilinder

---

[108] The word 'fourth' is written over a washed/scraped out word, as are the words 'which' (unusually here in its full form, rather than abbreviated) in the next line, and 'quadrup' in the line below that.

[109] This whole paragraph struck out with a single diagonal line.

83v

And y^e like body struck at a, and /another\ at b. and
another at c. will in y^e same time describe y^e
velocitys D. and E. and. f. for y^e spaces[110]

Then supposing a.d. = perifery a g. and
b.e. = perif. b.h. and c.f = perif. [b s.?] I say
that an Equall & like bodys struck at, a. b. &
c. shall move with less velocitys & exposed by
y^e Respective tangents. a.d: b.e: and c.f.
and each describing y^e ~~severall~~ /same\ Revolves arrive
at. B. d. E. & f. at y^e same moment of time.
w^{ch} is Evident by y^e construction for circles
are as the diameters.

Every Body, ~~as the whole Clinder~~ is Com=
posed of parts or Momenta, as they are termed
and the [~~Sum~~?] /force\ of ~~y^e each body~~ /y^e whole\ is y^e Sume of y^e
force of all y^e momenta, And those being allwais
understood in Equallity, y^e forces of y^e severall
momenta are Estemed as y^e spaces moved in the
same time /y^t is [on?] y^e velocitys\ therefore taking y^e velocitys of all
y^e momenta of this cilinder to be /to Each other\ as the con=
centricks a. b. c. y^e same layd forth in length
will describe y^e triangle A.B.C. w^{ch} Exposeth
the sume of y^e force of y^e whole body turning.

Then supposing y^e whole /to be\ progressive with
y^e ~~Extream~~ velocity of y^e /extream\ Turning A.B. All y^e
momenta will describe paralell lines (Equally
Swift) and fill y^e space A.E.B.D. ~~of w^{ch} the~~
w^{ch} Exposeth in sum y^e velocity of y^e whole
and of

[110] This paragraph struck out with a single diagonal line.

And of that ye triangle A.B.C. is just a fourth
part, QED.

The Consequence of this is that If a body Re=
Sisting at. D. will stop ye whole in its progre=
Sion, a fourth part applyed at A. will stop the
turning. but this action is understood to be In=
stanter, and in that Respect is No other then
Comon Impuls As A = B Impells it with the
velocity C.A. the body B. Shall pass to D in
ye Same time as from. C. and if with half the
velocity from E. the time of ye Access & departure
vist E.F. and. G.H. Shall be Equall and half
the former, and hereby the state of a diameter
is Reduced to that of Solute Impulses, and that
of ye foremer is Enough Shaddoed by ye prickt
lines. A.u. and F.s.

Hither to ye movemts. are supposed to be
directed from ye Diameter, and Equall
Quantitys with unequall velocitys. Now wee
should turne ye tables, and suppose ye directi=
ons to be towards ye diameter and Equall
[~?] velocitys and unequall Quantitys wch
would be found to amount to ye same,
but In Regard the Impulses falling with
obliquity with Respect to ye ~~s~~center, there
would be a progression as well as a turning
excited wch would create a perplext acco.

And

And that I shall Leav at prsent, and take
up plainer subjects, as for Instance Resistances
and ye Consequences; And becaus Everery body
Imp/el\led is a Resistance to ye Impelled, wch may
be more of less indeffinitely, I will suppose
the Resistance to be Infinite or Immoveable.

<diagram> Then considering as before that In a
body Esteemed moving in directum,[111] ~~Each~~ /all ye \
parts or Momentam describema paralell lines
Strait and Equally Swift. Such as In all Move=
ment are supposed as at A. wch body being
moved towards B. with all its momenta des=
cribes the paralells A.B. And as ye whole body
hath a perseverance in its State, wch Moving is
Called a tendency, so Each momentum hath for
its part ye like perseverance and tendency; wch
words I must use, having long since prmased the
Explication of them.

<diagram> Now when a moving body is Resisted, at any
point, the momenta on Either Side have a
tendency opposite. And those Sides are distin=
guished by a line from ye Contact ~~thro ye cen=~~ /paralell with\
~~ter of ye Impellent, ffor ye force of ye Resistance~~ /with the paths of yt direction, as
here ye body D\
~~is directed in ye Manner~~ /. directed from AB. the separating line is D C\ ~~as hath bin
Shewed.~~
and. A.B. and D.B, the opposite sides. If the ye
separating line pass thro ye center as F.E. there
is an Equallity of /ye \ tendencys & Neither can pr=
vaile agt ye other, And this Line C.D. I call the

[111] i.e., 'straight' or 'directly'.

<diagonal> gage, being directoriall in all cases direct or
obliqe that Can happen for Every momentum
in that line hath No tendency but In directum
to the Contact, but on Either side there is a
tendency, more or less Either way. As If ye body
A.C. In such posture In the Direction A.E.
B.C. falls upon ye obstacle at D. the para=
lell D.f. is ye Gage line. and No ~~part~~ /mentum\ of ye body
on on ye part of E. hath any tendency towards
C. nor E. contra.

But none of these Instances of Moving
bodys Impellens will Serve our turne at pr=
sent, becaus there is a Resilition from ye obs=
tacle; therefore wee must suppose that co=
hibited as may be done /by\ divers means as will
appear, and the the body E.C. Instead of fal=
ling Instantly into a Cours of turning upon
ye proper axis. will take a center. D. at the
point of Resistance, and if at all turne upon
that. and all ye rest wee have to doe with
is but the account and Events of Such tur=
ning. And this center will be Called the
fulcrum, and is ye cheif prsumtive in all ye
science of Mechanicall powers; but how ever
the body is held to ye fulcrum, It is to be
supposed onely against ye progressive, but
~~and~~ as to turning absolutely free.

85v

A body may be stayed at y^e fulcrum by a
magnetisme, or by a gluten, or by a Succes=
ion or /~~w^ch shall be here supposed~~\ Reiteration of y^e Same pulses, or by
a continuall flux or action of the Medium; w^ch
last wee shall have ~~onely~~ /cheifly\ to do with, and if un[=?]
stood by y^e terme gravitation, but the conse=
quents are y^e same in all as also If the union
at y^e fulcrum /should\ be by ~~y^e act of a living force~~ /mechanisme\,
~~as y^e hands of men, or /force of\ animalls.~~

At the contact the progressive ceaseth, /Just\ as ~~If y^e~~ [~~...~~?] /where\
body ~~were~~ /by its equall is directly\ opposed ~~directly~~, /And\ the cause of adhesion
~~that is /w^ch I suppose to be\ a continuation of Impuls/es\~~, permits No /separation or\
<diagram> further progress; as ~~here~~. A.D. in y^e direction
E.f. falls upon G. So as the Gage /G.H.\ passeth y^e
center. C. the continuing force from E.f. per=
mitts no Resilition, ~~and~~ /but\ turnes /as it were\ to Rest at. G.
ffor the momentu A.C. tending. In y^e /same\ direction
one way, /y^e same\ and those at D /~~likewise w~~ith\ ~~y^e Same~~ /of stop /[...?]\ between\
are opposits
and being Equall /Impede\ ~~are a full stopp to Each~~ others /process\
and this is properly a ballance, as Comonly
understood, wherein the Impulses /or motive caus\ ceas /[as?]\ not, bu[t?]
y^e Effect in the /whole\ body A.D. failes and is lost on
y^e Immensity of y^e obstacle. G. And when ever
any possibillity happen's for A.D. or any par[t?]
of it towards A. or D. ~~happens~~ /to move\, y^e Effect will ac[=?]
ordingly appear and in y^e mean time this State
is Called pressure, tendency or Conatus ad Motum[112]
w^ch allwais is Seen to work when y^e ~~obstacle~~ /Impediment in any degree\ ceaseth.

[112] i.e.,'inclination, or tendency, to movement'.

Of Muscular
action & force
ende par~~.~~ 309.[113]
The portions of our Substance subservient
to all our voluntary and Involuntary ac=
tions and are Called Muscles; however in
continuall use and observation are yet so
litle understood, as In their functions to be
more then wonderfull. The philosofers in
all times have strained hard to gain a tol=
lerable solution of them, the Result where=
of hath bin onely a Coyning of words, ~~and~~
such as facultus motrix, vis motiva, dispo=
sitio Cerebri, officium nervosum, Influctio
spirituum animalium,[114] and the Like all of
Equall Intelligence, as when Men talk they
know not what. The Cartesians are most
out of the way, who fancy an Effervescent
rarefaction of the blood In the heart as of
milk over y^e^ fire, w^ch^ by meer tumefaction
lifts up the [mucro?] and so forceth y^e^ blood
to vent by y^e^ artery's, from w^ch^ originall
all y^e^ powers of y^e^ body are Inspired. But
the whole Supposition is Contrary to truth
ffor first there is no such Rarefaction of the
the Blood.

---

[113] In top LHS margin.

[114] i.e., 'the capacity to move, motive force, mental (i.e., willed) inclination, nervous function, [movement?] of the animal spirits'. The word 'Influctio' is written over a washed/scraped out word. These terms are later (f. 87r) identified by RN as coming from Borelli's *De Motu Animalium* (see below), who had adopted them directly from Aristotle.

the blood in the heart, and[115] Next the very
heart acts as a muscle, and falls under
the Same Inquiry as all y^e^ Rest of the
genus Musculosum;[116] and that appears by
the Incessant action, Even after it is Evul=/sed\
from y^e^ body of a living animall, and the
manifest pulsations continuing for some
time without ~~any~~ Influx of Efflux of any
blood at all, but as some animalls Eluct
after both head and heart are deprived
therefore other Sources of vitall motion then
Rarefaction in the heart Must be looked
after. It is certein that the muscles act
with the advantage of mechanisme, w^ch^
hath bin demonstrated by Borellus. In
his book de motu animali.[117] But then he is
at great loss to find out the true & pro=
per Caus of Animall motion; And is dri=
ven to Insist upon a double agency, first
a proper force by Intumescence or Inflation
of the muscle; but that is found Insufficient
to lift so great weights, as are Raised by
the

---

[115] The word 'and' is written over an illegible washed/scraped out word.

[116] i.e., 'muscular kind', another 'scholastic' category.

[117] Giovanni Alfonso Borelli (1608-79) was a Italian natural philosopher who experimented in and and published on a wide range of topics from physiology to astronomy. Like Descartes, he enjoyed the patronage of Queen Christina of Sweden. His richly illustrated *De Motu Animalium*, (Rome, 1680) employs the same title as an existing work by Aristotle, and also used many of Aristotle's terms. It has been called the first treatise on biomechanics, combining not only a descriptive account of animal muscles, but also mathematical analyses of the mechanics of movement.

the members; therefore another agency
is Imployed, W^ch he Calls vis [motia?] or facul=
tas motiva, w^ch is no better then an occult
quallity, And if any such were it might
do y^e work without y^e help of muscles or me=
chanisme at all; And so all this Elabourate work
as to Resolving y^e mistery of Muscular action
is of No service, but further Inquest is to be
made, and If that in like Manner failes y^e Caus
is to be given up.

I doe Not undertake to discours of this sub=
ject with a view to Coming to a clear Reso=
lution of y^e whole, But If I can gain any Ground
upon it, I shall be well pleased. My first posi=
tion is that Every muscle is a perfect spring
amd acts by y^e like Internall principle, as other
Elastick bodies are observed to act;[118] And that is
by a subtile matter Inclosed in cavity's, w^ch
(cavitys) are obnoxious to Contract upon any
flexure[119] of the Substance and the action of the
Inclosed matter [~~Ela~~?] tends to Restore y^e figure
as was shewed when wee discoursed of Springs.
This Elasticity of a muscle hath for its station

or

---

[118] RN's position, that elasticity is enabled by pockets of 'subtile matter' which can compress and allow flexing, is maintained thoughout in opposition to Robert Hooke's argument in his *De Potentia Restituva* of 1678 (apparately Hooke had already stated the argument *as an anagram* in an an earlier *Book of the Description of Helioscopes*, of 1676, and had considered seeking patents for his ideas as early as 1660). Hooke was engaging with a problem earlier inaugurated by Galileo in his *Discorsi e Dimonstrazioni Matematiche* of 1638. Edmé Marriotte, 1620-84, a member of the Académie des Sciences, brought the two enquiries together, so to speak, and sought to develop general principles. Both were interested in the loading of materials in structures (the engineering issues, so to speak) as well as the issue of the return to original shape. Marriotte's work attracted the interet of Leibniz. See Hetnarski, R. B., & Ignaczak, J., *The Mathematical Theory of Elasticity*, Second Edition, CSC Press, Taylor & Francis Group, Boka Raton, Fla, 2011. *See* RN's further discussions of the topic, especially that following f. 336v, below.

[119] The word 'flexure' appears to have been washed out and then rewritten.

or place of Rest, the utmost [Contration?]. ffor
If a tendon is cut, the muscle, in whatever po=
ture it was, Immediately Shrinks up, and with y^e^
other flesh; and this force of Contraction is Not
So Slight as it may seem, for if a forceps were
applyed to the tendon, and y^e^ Muscle /being\ None
of y^e^ least /~~to be~~ drawne forth\ It would Require y^e^ force of a Mans
hand to Reduce to its former place. here is
no discovery of any vis motrix, or Motive
quallity but onely a natural Effect Comon to
all vegetables, nothing of w^ch^ kind is with=
out an Elater operating according to the /various\
plastick formations of them. And as to Strength
~~If taken~~ directly, mechanisme apart, It is
not to be singly taken, ffor y^e^ muscles of the
whole body are, for the most part, Especi=
ally In the largest attempts assistant ~~to Each~~
to Each other, operating Either together, or
or alternatively, as must be observed in
running, walking, and all Sorts of Labour
or agitation, of Men Brutes or foul. And
in Most of these Instances y^e^ mind or will
hath No power at all, as to Reduce a /disabled\ Mus=
cle, or to stop y^e^ alternative agitation's; But
now

65. phisica.

Now wee have to Consider the State of a
Single muscle and its dependences, of w^ch^ the
cheif are the one or more antagon~~istic~~all
muscles. there may be a force upon a Mem=
ber that shall hinder the Effect, or other Muscles
that draw Counter, w^ch^ May be with less or
more force, if the former y^e^ member to w^ch^ the
tendon is affixed is drawne /[?]\[120] If y^e^ latter p^r^vailes
it yeilds, so that the muscles, and their Anta=
gonists seem to be a variable ballance, to learn
as the advantage of power is given one way
or other; the caus of w^ch^ Alternation in
particular cases, is the cheif matter /here\ to be In=
vestigated.

Since wee can find No facultas motiva, or
other principle of action, but an Elater onely,
It seems Reasonable to Charge the Efficient
upon the Relenting muscle, ffor when that
Relaxeth, the effect follow's, and that /(Effect)\ being
by a force Notoriously Coactive, what need is
there to Search after any other, and /then\ the stress
will fall upon the yeilding muscle, and the
caus of its Relaxation, ag^t^ y^e^ force of ~~the~~ /it\
[~~.....~~?][121] /spring\

---

[120] Whatever was added here has been washed/scraped out.

[121] Both of these words are washed/scraped out.

spring supposed as to tractive power, to have
bin alter Idem[122] with y^e^ former. this occurrs
obviously, but whatever the caus of a Relaxa=
tion on y^e^ one side may be, (of w^ch^ afterwards) I
cannot Conclude but that the same agency
may at y^e^ same time Invigorate The opposite,
altho there Seems No Necessity for it, W^ch^ Matter
may be better Judged by what follows.

Taking a Survey of the Intire genus Mus=
culosum, the apparent means of all thats Mo=
tive in Animalls, Especially referring to hu=
man kind, (for Eminence~~)~~,[123] and what wee best
understand,) the Comon devision is Into vo=
luntary and Involuntary actions. to begin
with the latter, It is manifest that the
mind or will, neither Excites, nor Cohibits
the motions of the viscera, as of the heart,
Intestines, and the Conducts of the humours; The
voluntary are better knowne by the Expe=
rience and use wee have of our Exteriour
members, w^ch^ seem to be in our power to
move or Not and in certein Manners as

wee

[122] i.e., 'a second self'.

[123] The bracket is washed out.

wee thinck ffitt but Notwithstanding
this partition, I cannot but think that ori=
ginally all animall Motion is involuntary
and that the voluntary is but an Im=
perfect modification of that, ffor wee find
our Selves very unable to Imploy our mem=
bers as wee would, or in any Respect but
under certein qualifications and Circum=
stances concurring, as shall be shewed: for an
animall at first is a Creature begun and Con=
tinued by motion, and that necessarily Sub=
servient to Nutrition, w^{ch} is fiercest at first
but Continues more or less, to y^{e} finall dis=
solution. And what spontaneity is Joyned
in y^{e} animall, as to volition is a Single facul=
ty, and hath it beginning Even with life it
self, but appears Not in [act?] /but\ from the Na=
tivity; And then as to power, as I sayd, is Most
defective, and Grow's up by degrees but Never
sufficient to comand all the muscular Capa=
city, but Some parts, ~~and in a quallifyed Manner~~
~~and~~[124] or

[124] 'And' washed out.

or members onely. and those but lamely
whilst the rest of our Muscular [~~powers~~?] /Efforts\[125]
more Essentiall to y^e^ Continuance of life,
are wholly out of our power; And Now it
is Expedient to know whence these differen[=?]
ces, that is of voluntary and Involuntary
action's proceed. And that I charge [~~wholly~~?] /altogether\[126]
upon sensible observation or Experiment.
And that falls wholly upon the Exterior
member's, and not at all upon y^e^ viscera
The leg's and armes are Exposed to our
view, and obnoxious to application & tryalls
as well as /to the\ Imitation of other's, Whereupon
the benefit Encourageth continuall Endea=
vours to persue y^e^ Like advantages, and so
more or less is acquired. Hence wee Learne
to look, walk, run, and to subserve our ap=
petites, not as wee would, but as wee may, be=
caus our powers are Not absolute but Restrai=
ned according to more or less Capacity or ap=
plication. A child moves its armes & Leggs
being urged by Naturall Impuls or appetite
but

[125] The word 'powers'[?] washed/scraped out and overwritten by 'Efforts'.

[126] The word 'wholly' [?] washed/scraped out and overwritten by 'altogether'.

but it is long before it can Either look
or point Strait, or Even walk upright; all
w^ch^ Improvem^ts^ In children, are as manuall
arts, & practicall Exercises in Men, acqui=
red by observation, Endeavours, & Immitation
upon the whole wee Conclude that in
plants as well as animalls vegetative Motion
is perpetually Concomitant; and In y^e^ process of
life the differences are that plants shew onely
the distention or Increas, but In animalls there
are symptomes of sensation and volition, w^ch^
In humane kind are felt known & understood
And all push't on by nutrition till motion cea=
seth of w^ch^ y^e^ Least moment is death.

All our knowledg of muscular action, as
well, as power of Exciting or cohibiting the
use of it, is Confined to the Compass of our Ex=
terior or Grosser members, such as are Exposed
to our Sensible proof, by Handling, and more
nice anatomicall Experiments, and those onely
as to certein (but Not all) movem'^ts^ are Sub=
ject to volition. The muscles w^ch^ are
found

found to actuate these members, are of
various kinds, and for y^e^ most part act An=
tagon~~istic~~ally. It is reasonable to Consider well
the fabrick & Composition of these muscles, so
farr as Anatomy and sensible experiments Will
assist, and if in any one Instance wee can Come
to a tollerable Intelligence, all y^e^ Rest may by
Analogia be /Equally\ understood. To describe therefore
a muscle with its appendages, the body of it is
that wee Call flesh, w^ch^ is Soft, and may be Com=
pres't, as well as Extended; this at both Ends de=
termines in Strong sinues they Call tendons, w^ch^
are compact, tough, and Stringy, and at Each End
fixed to the bones of the members the muscle is to
work upon. and these tendons seem to be y^e^ very
Substance of y^e^ muscle, onely drawne Into a dif-
ferent Compendium. The appearance is that When
y^e^ muscle draws, it grows turgid and hard, and
the Ends come Closer together by w^ch^ means y^e^
member is drawn. It's sayd that y^e^ substance
of the muscle Consists of fibres, as they are Cal[=?]
led, but what those are Non Constat,[127] and No
sence however assisted will discover them, Nor
what

[127] i.e., 'not clear'.

what makes the Substance So bulbous In the
muscle More then in y^e^ tendon? therefore Con=
Sidering that wee have the Elator as well as
y^e^ matter to account for, and that the order of
y^e^ whole body is vascular, I conclude that both
muscle and tendons consist of tubes Continued
thro the whole, but strait in y^e^ tendon and Spira=
lised, contorted, or In some manner Conduplica=
ted in y^e^ muscle, so as to Resemble a Spirall wire
spring, as I Cannot but conceive a single fibre
to be. How this may Relax, and Resume the
tension, May be shaddowed, by Sheeps Guts [Reefed?]
for those will lye strait as a Cord, but Wind for=
ced in at one End, and stopt at y^e^ other will Make
the whole swell and curle up. and thereby lift
a considerable weight. and as y^e^ wind is more
or less forced in, so the Gutty spring draws. I doe
not bring /this\ foreward, to favour y^e^ Hypotheses
of Inflation, w^ch^ is Irreconcileable in Many Res=
pects, but of Nutrition as I shall shew. Here is
Enough to shew how a muscle may act as a
Spring, and become turgid or flaccid, as it is
freed, a left to contract it self more or Less

Now considering that y^e^ power of volition
is not absolute but Qualifyed, ffor making some
advance in the muscular Theory, wee will first Sup=
pose that an animall from its Nativity, to be wholly
unable to Controul ~~all~~ /any\ vitall acction, but as to all mo=
tion or action of its parts, altogether Involuntary. and
that y^e^ head, hands, armes Legg and feet, might move
but without any direction of y^e^ will more the heart
viscera, or other Insensible agitations of the animall
State. And then wee have a creature with these
Requisites; first an Internall heat, w^ch^ tho not
fire, hath all the processes of actuall fire; for it is Not
necessary that all fire should be Culinary, to discerp
matter into frusta,[128] and so dispers it, nor to Shew any
Lumen,[129] but fire as other powers may have ~~li~~ degrees
and act with like modes, y^e^ lesser, as y^e^ Greater. then
a constant supply, (as fewell) of An additional
recruit, w^ch^ failing y^e^ fire ceaseth, and y Creature
dyes. then a perpetuall motion of y^e^ parts and members
by w^ch^ the effects of y^e^ fire, thro various meanders
and divers changes ~~is~~ /are\ at last Exhaled. And if any
Incidents obstructs these passages, the fire choaks
and goes out. Now having made this paralell of
life and fire, w^ch^ is allwais observable, I will Endea=
to find some composition, w^ch^ In y^e^ practise of burning,
may serve for an Image to Rep^r^sent life directly.

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[128] i.e., 'pieces'.

[129] i.e., 'light'.

92r

~~73~~ ~~a~~[130]

It is In my thoughts to free my mind, by wrighting
of a ~~charg created~~ /cargo\ there, /created\ by a long series of Reflection
concerning Naturall thing's and severing the Reality's
of them from /y^e\ comon ~~acceptation~~ /fantasmes or shapes wee know them by\, W^ch hath heaped up
/In my thoughts\ many Notion's & distinctions ~~w^ch~~ /that\ demand to be brought
forth; And I propose to doe it in as good order as I
can, but with absolute veracity, & free from the vices
of /~~confidence &~~\ arrogance, ~~& domination~~ as well as too Much Con=
fidence, w^ch hath Corrupted /performances of\ Most of our Naturalists,
and Made their works of less credit, then ~~is~~ /were\ really their
due, ~~ffor Some~~ /on acc^o of divers\ very considerable discoverys owing to
them. ~~The Most harmless of these vices is~~ /for who hath passed clean from y^e milder of those vices\ Confidence,
and that In subject's w^ch cannot be proved, and at
best but guessed at. Such as /~~at~~\ all those are w^ch depend
on the Minute Component parts, & texture of sensi=
ble things? ~~and yet how positively have Men~~ /for authors usully\ pro=
nounce~~d~~ of them, ~~as If they had bin Educated In their~~ /as positivly as of the grossest bodys they dayly\
~~most familiar acquaintance?~~ /handle\ Speculative Men are
/most\ propens to this failing, ffor they frame hypotheses, ~~or~~ /[as?]\
~~May~~ agree/ing\ with Many ~~sensible appearances~~ /sensations\, & then
[Straining?]\ they /~~strain &~~\ argue them to hold in Every thing ~~Els~~ /[~~..~~?]\ ~~wherein their owne thoughts, & self~~ /It is generally self-\partiality /that\ Engages
them, (ffor those dear freinds to Humanity, opposi=
tion & Contradiction /rarely\ dwell In ~~No~~ Man's /privat\ Study ~~With him)~~
~~And /then\ they come forth~~ /~~they come~~ and then very loath they are to\ ~~with y^e assurance of Conquerors~~
/loos so Much Invention & paines\ litle Considering how the problematiq ~~takes place~~ / Reignes\
In Most ~~things~~ /sciences\, and Especially /In y^e Region of things\ ~~those~~, unseen; ~~And~~ where ~~all~~ modes and agitations ~~are~~ [~~..~~?] shun all /~~the~~\
possible examination.

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[130] For this next continuous section the paper size is slightly taller, but no wider, the paper quality is very slightly thinner, and slightly less opaque. The handwriting quite different (within the RN range of variation). Note that the BL numbering, previously running from 73, was changed during the compiling of this volume, the previous BL numbering has been crossed out in pencil, and sometimes erased/rubbed out. RN's numbering begins here at page 'a' and runs though to the end of this section at page 'dz' (f. 151v). It will be apparent by now that in these MSS, it is always the first few pages of a text that suffer the greatest number of alterations and corrections.

b.

the disposition of y^e^ Many /even of y^e^ learned as of y^e^ vulgar\ is to Contradict & Confute
rather then to Reforme and Correct. for When did
wee see any /~~The~~ failings ~~of ———~~in philosofy or style\ ~~good thing~~ mended,?[131] but on the
Contrary, ~~If any~~ /wee allways find where\ fault /is\ ~~were tho~~ /however\ Easily set right,
/and nothing either is or continues In perfection, yet\ for that very /small\ caus, y^e^ whole is Kicked downe.

I should take a view of y^e^ State of philosofy, In this
p^r^sent age, but before I come So low, I would ob=
Serve a litle of y^e^ More ancient, In order to Shew
how Error vanity & arrogance, y^e^ Corrupters of
science, come round and Ever will Interpose to
drive out that litle purchase /some\ Men's honest thin=
king have procured. ~~The Condition of~~ Naturall
philosofy, w^ch^ the Greeks called phisicks, was in
a Way off Improvem'^t^ till y^e^ age of Aristotle; Socra=
tes diverted y^e^ Study of it Much by Introducing, a
philosofy of another sort, such as Wee Call Morall,
but he did Not vitiate y^e^ other, as Aristotle did,
with a proud designe, of bringing y^e^ former /professors\ w^ch^
he /In a sort of Scorn\ Called phisicoi, ~~with~~ /Into\ Contempt ~~enough, downe to y^e^ du~~ and setting up a New Model of his
owne in y^e^ Roome /~~w^ch^ Mons^r^ Rapin[132] say's is rather a logic then filosofy being but a structure of words and termes~~\ The phisicoi applied themselves
to Resolve Naturall appearances, by ~~y^e^ Effects of~~
Reall substance, and Motion; And, as is thought, had
the knowledg of y^e^ worlds Imensity, plenitude,
~~fluidity~~, & Movements, as ~~are now beleeved to~~ /of late have bin thought true\
~~take place~~; so that the moderne mechanicall
/or corpuscular\ philosofy is Grounded upon & y^e^ foundations
of it

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[131] I read this mark as a question mark.

[132] René Rapin (1621-87). RN could have been stimulated by the publication of *The Whole Critical Works of Monsieur Rapin Newly translated into English by several hands*, London, 1706 (such an assumption would be qualified by the date given this text). Rapin's *Les Réflexions sur la philosophie ancienne et modern, et sur l'usage qu'on en doit faire pour la religion*, was published in Paris in 1676, and was translated into English in 1678. RN had also learned these criticisms (or similar criticisms) of Aristotle from his brother John (see the *Life of Dr John North*, etc). RN's opinion of Rapin was not wholly positive, *see* Add MS 32546 ff 171v-172r.

of it taken from these ancients, w^ch^ Cartesius
& some others doe Ingenuously confess; those
Ancients had some Notion's, Now layd aside, such
as atom's, for It is found Matter is devisible, and /I think\
much of it actually devided, In Infinitum. they
ascribed to Matter a devious Motion, In vacuo
Infinito,[133] whence they argued y^e^ Justling of things
y^t^ occasioned y^e^ variety's of y^e^ world, & when that
would Not doe, for how can things Justle that
March all one way? then they were to Move
laterally, & so Crossing one and other, were to
do y^e^ Same thing. but y^e^ Modern's have layd aside
th~~i~~/e\s/e\ and for what reason's May be touched here=
after. but Generally the ancient phisicoi, aimed
to Resolve Natural Question's, in a Mathematicall
way, as neer as they Could; and how plausible /a method\ that
was /let\ the opinion's of y^e^ p^r^sent age /valued for it\ Declare.

It seems that y^e^ art of disputing was come to great
perfection about y^e^ age of Aristotle, who was a Re=
ducer of it Into Method, and a great founder of
y^e^ logiq wee use. And the Scope of ~~Aristotles~~ /his\ phisicks
was, Not to find out truth, & to make it plain, but
to set up a new model of Naturall Philosofy, &
confound y^e^ former, Continuing it so as the then
power of disputing Should Not be too hard for it.
If he [secured?] that his tenents were Such, and in
Such termes as Could Not be /logically\ Confuted, all was well.
Therefore

[133] i.e., 'in an infinite vacuum'.

d.

Therefore he Invented, New termes, & /many\ Qualitys /for principles\ as
also a world of empty, unscientificall distinctions
and scarce touched a true plain caus of any thing
In ye World; of wch any one May be satisfyed, that
will look into ye works of Bacon, Gassendus, &c. And
Monsr. Rapin[134] will tell us that his phisiks are ra=
ther a logiq then a philosofy; wch is sayd to Ex=
cuse him, being a favorite of ye Roman Theology
funded in disputing whereto he is wonderfully
assisting. No wonder then, that the Grand hierarky
took advantage from ye Works of Aristotle, to set up
that twisting trade of ye Scoolmen, to Make ye plaine
Duty of Man, and the clear principles of Christian
Religion, an Inextricable knot of Eternall dispute,
Subservient to an Immens usurpation of power, but
litle to truth, where of Not one Single grain was Ever
~~found out~~ by ye help of it found out

It is admirable to Consider, that about ye time of
Reformation of Religion In Europe, when men be=
gan /to\ free their minds from ye tyranny of disputing
and Endless, as well as Unintelligible distinguishing
In Matter's of Religion, and Ecclesiaticall autho=
rity; the vertue penetrated Into all other sci=
ences, and philosofy it self, began to look out
Into fresh air from under the Same clouds. Then
The authority of Aristotle began to be Questioned,
a daring thing, wch raised almost a persecution
as If the GoSpell had bin blasfemed. The history
of this

[134] Francis Bacon, 1558-1626 and Pierre Gassendi 1592-1655 were both notable critics of Aristotle and the scholastic method (what RN here calls 'disputing', or the 'twisting trade'). Rapin, a Jesuit intellectual, although critical of Aristotle, was even more critical of the New Philosophy (notably of Descartes) and wrote as a defender of Catholic doctrine and the scholastic tradition.

~~75~~ ~~e.~~

of this Matter, May be observed from y^e^ works
of Bacon and his Cotemporary's, to w^ch^ wee Referr,
But that authors name, being of o^r^ owne Nation
gives me occasion to observe how litle a popu=
larity in philosofy is to be Regarded. ffor his
works had No credit Nor acceptance with our
vertuosi or university's, till they were Eccoed
So strong from forrein parts, that Men were a=
waked, & looking /More Seriously\ into them found those Noble
Hints w^ch^ Conduced so Much, as Nothing More to
the Inlightening of Naturall philosofy. Its true he
is guilty of No hypothesis, and points to y^e^ way, ra=
ther then goes before to shew it, w^ch^ was Not Mis=
becoming a man of his post in y^e^ world, (however[135]
unfortunate~~ly~~ ~~in~~ y^e^ Catastrofy.) ffor affairs would Not
lett him put in practis, what his Great Mind suggested.

Now wee find y^e^ world In a way of being Manumi=
sed from the disputing, to Injoy the free Searching
part of philosofy; but Not ~~Compleately~~ /so fully\ till the time
of Cartesius. who built upon y^e^ Model of the an=
cient phisicoi, Corrected & layd aside as he thought
ffitt, discharged all that Came after as useless to
y^e^ obteining truth's, chalked out a method of Exa=
mining all thing's, and Regulating y^e^ Judgm^t^
upon the surest foundations Nature hath allowed,
And from Generall Reflection's, In y^e^ way of Meta=
phisick's, gathered y^e^ Certeinty of our beings and
understandings, proved our faculty's true, with
other

[135] This is a rare example of a bracket integrated into the formation of the first letter of the next word, thus showing/proving that RN sometimes (at least once) included brackets as he wrote. The 'Catastrofy' was Bacon's conviction for corruption in 1621, and his subsequent exclusion from public life.

f.

other Important Notions tending to an assur/e\~~ance~~
~~of~~ our Stepps, In search of truth. And proceeded to
the Mundane Systeme, opened y^e^ Univers to Infi=
nity, formed a systeme of y^e^ sun & planets, with
great facility upon the Model of Copernicus,[136]
Supposed y^e^ world Repleat, and Motion to be the
life of it; In w^ch^ Cours he ran so ffarr as to pre=
tend to solve y^e^ Magnetisme of Iron stone, &c. &
So Gravity, light, & Colours, &c. for subserving w^ch^
~~particularity's~~ /porposes\, he Stufft his Mundane systeme hid
a parcell of particularity's, as Globules, particula^e^
striata^e^ & y^e^ like; All w^ch^ are in dark minuteness
and Can neither be argued Nor proved. In short
~~Of~~ /he was\ so great an Inventor ~~Never any~~ /In philosofy that No other Ever\ brought
forth
~~So much~~ /more\ of truth, & ~~so~~ New /then he\. And If in some way's
of Expression y^e^ thought is Not delivered so pure, as
/I fancy\ It was In his Mind, /ffor opposition onely & objection setles formes of
speech [.?]\ it is Not to be wondered at, for
when was any new Invention produced perfect at
ffirst? And If he carryed his Confidence too ffarr, In
being very positive In subject's w^ch^ cannot be Ex=
amined; it is Excusable on acc^o^ of humane fraile[=?]
ty, for who Ever alone subdued all his owne p^r^=
judices. Therefore to him wee Must owne the
Invention of o^r^ Moderne philosofy, Whatever
Cry hath bin raised, and yet Continues to the
p^r^judice of his works, as If he were an heretick
and author of a pernicious sect rather then a
philosofer

[136] Nicolas Copernicus (1473-1543), Polish mathematician and astronomer, whose analysis of stellar and planetary movements led him to propose a heliocentric model.

philosofer.

It hath often fallen In My Mind to observe, the ill
usage this author hath Met with in y^e^ world, w^ch^
ly's cheifly In this, that Notwithstanding they
ow the light of their Eys In great measure to him,
and run away with his Notions Refining on them,
& then Calling them their owne, they are Not Con=
tent, not onely to allow him Nothing, but to
depreciate & Revile him; And this by No one More
then his Notorious plagiary's. Instances ~~of this~~ are
plaine and Many; as that process of the Earth's
formation; w^ch^ Cartesius Modestly owns but as a
possibility, & Not as truth, Supposing onely that
Such principles as he advanceth, would at this time
out of such Materialls as a Caos, produce such a
thing as y^e^ Earth is. But D^r^. Burnett with his theo=
ria telluris sacra,[137] Makes ~~this his Invention~~ /~~it~~\ /will have y^e^ cration [ruled sume-such?] way as he hath projected\, & En=
gages Moses to vouch it. And at y^e^ Same time with
y^e^ Greatest arrogance, despises & Reviles his Master
And a like traine of others of y^e^ Same Meal wee
have spinning out of Cartesius flax, Neither ow=
ning nor so Much as well speaking of their author.
~~In like manner~~ Cartesius /also\ professed to treat Natu=
rall thing's More geometrico, and pretended to Es=
tablish them upon principles of Equall Certeinty
as Mathematicall propositions. Then Comes forth
M^r^. Newton, with a book, bearing that very title,[138]

and

---

[137] Thomas Burnett (1635-1715), *Telluris Theoria Sacra, etc.*, (first Latin edition) London, 1681. See the similar argument made in the '[Essay] on Authoritys', in Add MS 32546, in particular regarding Burnett, at f. 221v.

[138] i.e., Newton's *Philosophia Naturalis Principia Mathematica*, first published in 1686/7.

h.

and how well he useth Cartesius, after his using so
Much as he doth of his ~~ph~~ philosofy, May be Shewed
afterwards.

I shall conclude this discours with Noting some generall
thing's In y^e^ principles of cartesius, with the caracters
of them, and the vertues or failings. And first that of
the plenitude of y^e^ World. this is one matter wherein the
latter philosofers batter cartesius; and I know No
~~one~~ argument ag^t^ it, but one, w^ch^ is y^e^ difficulty of Mo=
tion, w^ch^ I shall ans^r^ In another place, ffor I am
In this of y^e^ Cartesian faction. The advantage taken
is from Expression's, or manners of Arguing. ffor Says
cartesius, Extension and body are y^e^ same thing.
a vacuity is a Contradiction & Impossible, for If No=
thing /is\ between any 2. bodys, (as y^e^ Sides if a vessell.) then
they Must touch. Now say they, wee have a Notion
of space, devided from that of body, Ergo it is possi=
ble. /And If possible why should it not be? ~~w^ch^~~ so say they\ ~~and~~ Extended body is one
thing, & space Extended
without body another. And ~~So~~ /thus\ the/y\ ~~party's~~ differ. Car=
tesius argues from the thing; wee know Nothing of
body but Extension, why Should wee suppose any Ex=
tension y^t^ is Not body? or why should wee assigne to
body any ~~other~~ /different\ Essence /or Intrinsick property\ since wee have No dis=
covery or proof of other then Extension /all other propertys are deprivable but that
holds thro all possible tryalls.\. If men
will assigne to body any essence apart from Exten=
sion, or /any\ Inherent Nature or Quality's, as principles
or hypotheses, to serve turnes in Resolving Natu=
rall Questions, they are all Gratis dicta, & May be
denyed

most part,[139]

[139] It is not unusual for RN to leave a marginal note to himself, or even to jot down an idea in the margin as it springs to mind.

~~77~~ ~~.i.~~

denyed as readily as assumed; and there is No End or
certeinty, If wee goe upon suppositions of thing's wee
have No experiment of, Especiall/y\ If ~~that be~~ /meer extension\, as he
affirmes, /be\ Sufficient to /ans^{r}\ all ~~porposes~~ /occasions\ In Naturall science.
The other's argue onely from their owne Imagination
that is, that becaus wee have an Idea of vacuum
or Space apart from body, therefore it is. This May
be said to be but a vulgar, & Not a philosofi=
call way of arguing, for what wee can ~~thinck~~ /Imagin\
or Not, ~~thinck~~, Signifies Nothing to the ~~truth~~ /reall existence\ of things
/w^{ch}\ ~~and It~~ may /or May not\ be /what Every formes ffly In our Imagination\ ~~Either Way, for all that~~, or at least
our Imagination /of things\ is No Necessity /~~of the~~\ Nor Indeed so Much
as an argument /of their Existence\ And that Idea /we have\ of a vacuum, is
In truth but and Idea of transparency /or [Insibility?] as\, becaus wee
see /or feel\ not that w^{ch} is in a vessell, wee argue ~~there May~~ /it is\
possibl~~y~~/e\ /there may\ be Nothing /at all\ in it. And If our vision and touch
were so Nice, that wee Could Not ~~&~~ /Nor\ Ever yet Could
by any of our Sences perceiv an (idea of) Emptyness
wee had /had\ No Notion of it, and y^{e} Same argument
had held y^{e} Contrary way, vis^{t} that wee Could Not
Imagin a vacuum; ~~So In~~ /therefore there was none; so ffor our Notion of\ time, our
argum'^{t} that.
it is /a thing\ Ceasless, is /wholly\ taken ~~from our~~ /built upon like\ Imagination. ~~w^{ch}~~
/for\ being
Continually sensible of time, wee cannot Conceiv
any beginning ~~or~~ End or lacune in it /to be\ possible.
And If /by such accidentall means in time as Instance\ wee had perceived, ~~Such seeming~~
voids in
~~/of\ time~~, as /by an ~~empty~~ vessell Repleat only with air\ wee doe of body, ~~/like\ as in vessells full onely with air~~, wee had /had\ a like Idea of No time, as
we have of No body, & argued from it as strongly.
/w^{ch} shews how vain it is to argue from Imagination\

96v

k.

Therefore Cartesius seem's to have the better of the
philosoficall problem, as grounding on thing's (so
farr as he Concludes) certein, against ye adversa=
rys, that have No argument but ~~their owne pre ju=~~ /Imagination\
~~dice, or opinion, as If Nature were to follow human~~
~~Imagination~~, wch wee know chimericall & Confu=
ted in 1000 Instances. And /as\ for ye ~~Instance~~ /assertion that\ ~~o~~/i\f a ves=
sell /be\ supposed Empty /~~therefore~~ ye sides touch\ that is Indeed ~~a Sume of Words~~
~~& No /& litle\ argument, & rather /but serves as\~~ a peice of witt /rather then
argument\; ~~for it~~
~~is concluded by others~~ becaus ~~If there can be No va=~~ /the question is whither they\
~~cuum the vessell cannot be Empty; or in that state~~ /touch or no; yet it is scarce easy
possible in termes, to say what\
~~a vessell~~ /keeps ~~parts~~ ye sides asunder\./when nothing, (and Space meer empty is /mere
\ Nothing) /is\ between
them; such puzles will happen, when reality's are argued onely from fancey.\

As to the Case of Motion, they say yt In ye winding
about of body's, as must happen In promiscous
Movement, there Must be angular Spaces, Infinite=
ly Small, wch cannot have part's formed exactly
to fill them. therefore there Can be No Motion
without vacuity's Interspers't. I answer. 1. that
Admitting vacuity In ye World, yet the same diffi=
culty Remains, ffor ye Matter of our World Rolling
about a Center, hath a perpetuall Crowding
from it, so that If there /be\ any vacuity It would be
about ye Center /of ye Motion, that is, ye sun.\. but It is certein yt force of Recess
from the Center /combined of all ye Intermediate substances\ is Stronger then ye
Movement of /any\
~~any~~ /~~some~~\ subtile part of matter; whereby If ~~In turning~~ /to Reconcile Motion\
/it is necessary\ the Small body's, Must Make way against that /Imens\
force, to Gaine Room, litle ~~motion~~ /swing of things\ would Remaine.
/In ye World\ but,

but then. 2. I ans^{r} the objection fully, by alledging
~~an~~ /an\ actuall Minuteness of body to Infinite. ~~It~~ is Matter
of ordinary dicours, that Matter is devisible ad
Infinitum; wherein they ~~mean~~ /Intend\ Mentally, but Not
by any ~~ad~~ actuall means; And I doe Not suppose
otherwise. But yet however it Comes to be so, I must
Account that there is No limitts In y^{e} actuall Smal=
ness of matter, ~~but~~ /And\ affirme In y^{e} Mathematitians
phrase, that there is /here & there &\ almost Every where /Intersperst\ Matter ~~In=~~
~~tersperst~~ Smaller then any space assignable /that can happen\ So as
No space can ~~happen~~ /be assigned\ so small, but Matter of Conge=
ries of matter is at hand /much smaller\ to Supply it. And. 3. I Say
that admitt, /some\ body's that touch May Not happen to
devide /againe\ for want of apt matter to Interpose, yet
other's may Not be so [pent?], so that Motion May
be In some Instances Impeded, & In others free & those
/[a?]gaine If parts cohere for want of accomodating one sort of Motion, another may
part y^{t}\[140] Enough to maintain y^{e} action of y^{e} World. 4. lastly
It is Impossible that Influences should be conveyed
to & fro, from all part's of y^{e} univers as wee perceiv,
In y^{e} forme of light. If Empty spaces posses't the
Greater part of it, as M^{r}. N. most ~~p^{r}sumptuously~~ /amazingly\
Insinuates. w^{ch} matter is discust in a proper dis=
cours of light.[141] ~~It is to Make all /Naturall\ knowledg & p^{r}ten=~~
sion to it, ~~as to Naturall causes, the advancing~~
~~such~~ /the\ contradictions, as he maintaines of that sort /are stupendious\
~~ffor~~ /for\ Not onely /~~Makes natural knowledg in y^{e} [....?] of~~\ light /w^{ch} [he?] say's
is corpuscle but\ ~~but~~ /~~In other Respects [is sett?] up~~\ attrractive, dispersive,
centripetall centrifugall &c. powers /~~w^{ch}~~\ are to work
Effectually a [thwart?] meer vacuity's; but of these

in

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[140] It is not clear how this additional text fits into the whole.

[141] This reference to Newton offers an argument for a date for this section of the text as post-1704, the year in which Newton published the first (English language) edition of his *Opticks* (a 'proper discours', as opposed to the various writings on light that appeared, for example, in the *Phil. Trans.*).

m.

in another place, where I purpose, to bring together
his Monstros tenents, by w^ch^ it will appear the
Geometer hath Spoyled the philosofer.

It will be materiall to My Intended discours
of loco Motion to consider what our Notion of
place, & what the thing /itSelf\ is, & Not amiss here, being
Conducing to the Maintaining an universall
plenitude. laying aside the puzles about defining
or describing place, supposing, that however wee
may Not agree in words wee mean y^e^ Same thing,
My proposition is that place is onely Relative, &
Not absolute, as M^r^. Newton Maintaines. Whereby
it is supposed, that If there were but one body
In y^e^ world, at larg In vacuo Infinito, It Could
properly be /sayd it is\ here or there; w^ch^ I utterly deny. If there
~~were~~ /Must Necessaryly be\ place without Relation to body, that is /absolute conceived
by\ abs=
tracting all body (Mentally) from y^e^ World /and\ yet ~~place~~
that ~~is to say here & there~~ /place, meaning here or there,\ absolutely & eternally
fixt ~~must~~ /shall\ Remain; /then\ Something & Nothing are
Reconciled; or /Els\ Spa~~s~~/c\e ~~is a~~ /becomes a ~~necessary~~\ being, like the devinity
Immortall, as having a Necessary Existence. And
All the while, goe to the reality, what? wee Say
Nothing, he says space; that is talking In a
circle. space empty is Nothing, and yet Space,
w^ch^ substantive word Imply's something. But take
away one p^r^judice, w^ch^ few can shake of, ~~but~~ /for most\ Suffer
It to Influence ~~y~~^e^ /their\ Judgm^t^ In almost all discourses
of Motion

of Motion, and the Controversie drops. that is Men
while they Speak, account their owne persons, as
one of the termes, or as a standard for Judging of
all place & Motion'. ffor who Say's here, or there
but with Respect to his owne person as a Standard;
and then In truth, the absolute space or place, w^ch^
of its self is Nothing, becomes something by Relation
to ~~his owne~~ /the speakers\ station. Therefore all that apperteines
to place, subsists Intirely with Regard to somewhat
~~it is~~ collated ~~too~~ /with it\; whence wee say here, there, farr
neer, high, low, & y^e^ like. Thus hard it is for Men to
abstract the Most vulgar of p^r^judices, and argue to
y^e^ Nature of thing's, from their Imaginations, p^r^suming
that Nature it self Must truckle to our defects, and
that Essences, possibilitys, & Impossibilitys must wait
upon our Conceipts. So Much for vauity, plenitude &
space.

There is another Speculation w^ch^ falls In with this,
And it is of Time, w^ch^ is well Enough understood by
the Comon definition of it /vis^t^\ Comparison of Movem^ts^.
I have onely to say of it, In this place, that it is as
motion attendant on body, and Mensurabe by y^e^
ordinary Extension's of thing's, and hath No Standard
or Criterium, or other difference, w^ch^ doth Not arise
out of comparison of dimension's, one Cannot find
any Quantity of time, but by Some Quantity of Space
assumed for y^e^ 'nonce, as y^e^ Sun's annuall cours. and

0

and that Subdevided Measures the days hours, &c.
w^ch^ tho very Irregular & Inconstant, as astro=
nomers say, and perhaps In stricktnes Incomensu=
rable, /yet\ serves the occasion, and y^e^ Mind, w^ch^ is thought
/so\ Sensible /a judg\ of time, discernes it Not. It is an hard Speech
but, In My opinion, very true, to say, that /If you\ abstract
/all\ body, ~~and~~ time is Gone; Neither 'fore Nor after
Remaines; And M^r^. Newtons absolute time, is No
longer lived then his absolute space, coeval with
body, & Not otherwise. And what is to be argued
ag^t^ this? wee Cannot Conceiv /say some\ but Whatever be=
comes of us and y^e^ World, time must Remaine
and 'fore & after continue. No Wonder, for Wee Ne=
ver lived a moment, but Either senible of time,
or (supposing wee slept, & felt No time) that o=
ther ~~any~~ animalls were awake to keep the acc^o^
going; ergo time /as well as space\ is like y^e^ diety, Immortall & ~~Inexpug=~~ /Eternall\
~~nable~~ of this way of argument, I have said enough
and Need Not add on y^e^ other side devine authority
w^ch^ in words & sence prove ~~otherwise~~ /y^e^ Contrary\ - before abra=
ham was I am. that /oracle from a sublime Example Inferrs\ ~~is to~~ being's. Not
dependant
on body, & /& Not ~~not~~ like us Creatures\ having all their /sensations & most of their\
thoughts from Corpo=
reall Impressions,) ~~as wee humane Creatures are~~,
know No time; but Wee can Scarce, tho it be Gos=
pell, beleev it, becaus wee Never felt it. In a
word to Returne to o^r^ argument, that w^ch^ Exists
wholly in Estimates of Motion as time doth Must
stand

~~80~~ p

stand and fall with body, and that ceasing be
no More.

I cannot pass by another Speculation w^ch^ is of
Magnitude; a subject y^t^ hath Created much dispute &
puzle as well as admiration /even\ among the vertuosi.
As whither wee discerne or can have knowledg
of the just magnitude of things: & y^e^ like. but When
the Extended Spaces of y^e^ world are Rep^r^sented by
Relation of any thing wee know, as When the good
Mons^r^ Hugen's proved a canon bullet with its prime
swiftness continued, would Not Reach to the Great
dog starr, Sirius, 25000 years, wee are amased,[142]
And on y^e^ other side in y^e^ Way of [decrement?], that an
Inch hath Infinite parts, and No Moment of Quantity
hath any defect from its Exility, but is Induced with
all demension's and powers, as other body's have, onely
bating for measure. but a triangle & globe, Incon=
ceivably litle, hath all y^e^ property's, of y^e^ Greatest
and (w^ch^ is More) is yet devisible In Infinitum; this /ordinarily\
is accounted distraction, and were it Not supported
by y^e^ Joynt authority of all Intelligent persons, /Geometricians as well as
philosofers\, would
by y^e^ comunity of men /be\ Hist & derided. Now all these
difficultys & wondermenrts will dissolve If wee Consider
that Magnitude is Nothing, but onely Comparative.
ffor If there were but one Globe, or triangle In the
world, It were all one whither it were Greater or
less; And No Magnitude Could be assigned to it, or
ought truely to be affirmed, but that it is Extended
or body

[142] Christiaan Huyghens (1629-95) wrote a general account of cosmography, *Cosmotheoros …*, The Hague, 1698. Although completed by Huyghens before his death, it was published posthumously. It was translated into English (from Latin) as *The Celestial Words Discovered …,* (London, 1698) even before a Dutch translation. RN here refers to the chapter 'A way of making a probable guess at the distance of the stars' [vol II, p. 153]. The text is available online at http://www.staff.science.uu.nl/~gent0113/huygens/huygens_ct_en.htm.

q.

or body. And all that is true of one Globe or triangle
~~(I mean prisme,)~~pyramid) would be true of any o=
ther's in their places if these were away. But When
wee suppose, divers body's to fall In y^e^ Same view,
then a New Essen's start's up that is Comparison /or ration\
and difference of Extension, w^ch^ gives Imployment
to all Mathematick Sciences. The fault here is
that wee cannot Imagin ~~but~~ /that\ one, /body alone exists\ abstracting our
owne body's /w^ch^ will obtrude in our minds\ to Make another, & then Comparison
Enters. But be pleased, and Say this Solitary Globule
is a great one, p^r^sent your Self that are vastly lar=
ger, & then you say it is a Small one. But yet, Say
you, Admitt this Globule In view, Increast by adding
Equally quantity to it, then it is Not y^e^ Same as it
was; true, becaus you Compare it with it self, w^ch^ is
y^e^ Same as with another. So that turne y^e^ Matter as
wee will, wee cannot find any Reality In Magni=
tude, but by Comparison. ffor If y^e^ whole world were
~~Manga~~ Magnified, all part's alike In proportion, No
sensitive thing could find any difference, so If y^e^ Same
world, were, by an almighty power, with all y^e^ parts
of, or in it deminish't to a Nutshell (as I may Say)
the creatures would have y^e^ Same judgm't^t^ of Magni=
tude. The reason is they make themselves the Com=
mon Measures of thing's; and such as much Exceed
them, are Esteemed very great, and other's that are
so small as to escape their ~~Gross~~ scrutiny, are accounted
Even of feeble Existence, & ready, If any thing to
become

become Nothing; therefore Nothing of Quanti=
ty or Number is wonderfull. and a proportion of
1/10. is No More plausible then 1/10000 &c, If y^e^ fraction
were Extended In a line Reaching to y^e^ fixt
starrs. But from Comparison of Magnitudes wee
are but Extension, In our Sence, arise Infinite vari=
ations of thing's. as the differences of space, Number
Quantity, weight time, & Every thing Els, falling
under the sciences of Extension Called Mathema=
ticks. And there wee are to look out for the Source
and originall off all our variety's, In What shapes
soever they appear to us, Whither sound, light,
tale, weight, time & y^e^ like.

Having touched upon y^e^ Mathematick sciences
whose Sphear is Quantity or Extension, It Comes in
My Mind to observe a comon mistake, like others
that happen In men's sentiments of things, when
their personall value is concerned. (ffor self flattery
is y^e^ very head Quarter of Error.) And that is the high
Esteem set upon the capacity of humane minds
Exercised in Mathematick operations; & particular=
ly In y^e^ way of Algebra, w^ch^ is y^e^ Most Compendious.
And by late author's Exalted almost to pitch of devinity,
as who will may see In Malbranch;[143] Whereas In truth In=
stead of Eulogy's, he ought to have lamented the poor=
ness of humane Capacity, to have Need of such wretched
shifts, w^ch^ argue more defect, then ability. It is Made a
Symptome of Ideocy, Not to tell ten, and really it is
very

[143] i.e., Nicolas Malebranche (1628-1715).

.s.

very ~~Nerl~~ Neerly our Comon Case; ffor altho wee can
count ten successively, wee cannot Retain an Idea
of ten, without some forme or marks by w^ch^ wee are to
know it. If cards were made with y^e^ stamps out of
order & accidentall, It would puzle a Gamester to
Count his hand, without telling his pipps. as ffar as
4. 5. or 6. wee have a ready knowledg, when the
numbers of any thing are layd afore us; but beyond
wee must choos some shape, mark, or symboll, to know
y^e^ Number by. ffor wee are Not Capable otherwise to
know them, Nor have wee in our Minds any Idea
distinct of larger Numbers, much less rations of
other Quantity's, and Must obtein them by ~~p^re^~~
premising, & discoursing from what is p^r^mised. And
So taking y^e^ totum's[144] In peices, and putting y^e^ peices
together againe, w^ch^ is but a sort of practick experi=
ment (If I may so Call it) tho performed in y^e^ Mind.
And I can liken y^e^ Mathematick arts, ffor p^r^eminence,
to Nothing More then y^e^ Skill of almost Every blind
man, who /often\ can from touch & sounds discover as
Much as many doe with all their senses, as Mathe=
matitians by their, premises & discourses, /endeavour to\ supply
the Inability of humane Capacity, ~~as to all Imme=
diate Comprehension's.~~

It is Not Improper here to take Notice a terme
Much used by y^e^ vertuosi of all sorts, & that is Infi=
nite, & Infinity; There is No question what is Meant
by it, ~~but~~ /for\ all y^t^ use it artists & others are agreed
that it Mean's onely, Repetition of y^e^ same Ideas

In

[144] i.e., 'wholes'.

In succession, without thought of any End, probable
or possible. as Infinite space, is the Ideas wee have
of distance added to one and other, Infinite Number
Much y^e^ same, as If an order of Numbers were Conti=
nued as space, without End. Infinite devision, is a per=
petuall Repetition; Infinitely small, is y^e^ Result of
Infinite devision. but becaus the word is often used
substantively, y^e^ Notion has bin quarrelled, ~~as If it
were a certein account~~; and they have put cases
of adding & substracting Infinites /& Eternitys\ and So forg diffi=
culty's & Inconsistences, & charge them on y^e^ Notion
of Infinite, as /if\ that were No better. There is to Much
of it In Hales Origination of Mankind,[145] as is fulsom
to read. /The error ly's In taking Infinite for certeinty w^ch^ is positively, no
certeinty & so cannot ~~come~~ /fall\ in any acc^o^ or [~~..~~?] ration\ Cartesius to avoid
these Cavills, used the
word Indefinite, and In y^e^ Sence I have proposed, y^t^
is, No knowne termination. but that was onely
to Evade y^e^ lash of his adversary's of y^e^ Roman
faction, who would have accused him of Ma=
king his Infinite world Equall or coordinate
with y^e^ diety, /had\ he used that word, so knowne a de=
vine attribute. but where is y^e^ difference between
y^e^ one word & y^e^ other; without End, or undefined,
The Mathematitian's who will Endure No confusion
or ambiguity, say /thus, Infinite is either\ More, or less, then any Space or
part assignable. so that as often as you make
a step foreward, they take a step beyond, & this
In their sence is Infinite, and it is that w^ch^ /with cavillous people\ wee
can, ~~upon cavill~~ /best Resort\ ~~appeal~~ too;

Eternity is a word of y^e^ Same Import, for Endless
time

[145] *See* note on f. 40r, above.

v.

time, Is Infinite space, or Number of spaces Revol=
ved, and as space extends ante, & post, so Eterni=
ty is a parte ante, & a parte post. and as ye begin=
ning, so ye end of thing's must be ye act of an Al=
mighty power; ffor Nothing is so surely Revealed
to be his will, by Never failing Experience, then
[marg: *] that ye World will continue in ye condition It hath
and so Every Individual in it, subject to ye
Rules prscribed them, till a finall doom be past
upon it.

I Must distinguish Infinity Into Mentall, & actuall,
the former is ye Comon sence of philosofers who
Suppose, for Instance, Infinite Subdevisions of things
but this Mentally; for they doe Not say that it is
possible to devide very Minute particles of Matter.
But I must suppose, as hath bin hinted Elswhere,
that /some\ Matter is ~~Not to be~~ /sensible onely\, but is actually so devided.
and ~~accordingly~~ severed. Wch in ye Mathematick
style is, that there is /some\ matter actually Smaller, then
any smallness you shall assigne. And this I take to
happen ~~In almost~~ /about\ Every place; as /for Instance\ within ye limitts of
comon flint stone, there are Interstices ffilled with a=
-nother sort of Matter, wch is finer then the Component
part's of the flint; then in ye Interstices of that, there
is yet ~~finner~~ finer, & In ye Interstices of that ye like,
& So to Infinite. And you May as well find limitts
~~to~~ Mentall ~~devision~~, as ~~Off~~ this actuall devision,
And Neither hath any ~~Ground or~~ reason ~~wherein~~ /one More then ye other\

to

~~83~~ ~~w~~

to argue any limitation or stop. All y^e^ difference
I can find betwixt 'em, is that y^e^ former carrys a Ne=
cessity of devisibility, but y^e^ latter Not, ~~as to~~ /of\ actuall
devision; ~~But according to My sentiment of Naturall~~ /And\
~~thing's,~~ this actuall Infinity is of ~~that~~ /greatest use and\ Importance
for Reconcile/ing\ as I thinck it doth, ~~almots some~~ /severall diffi=
culty's /In nature\ other wise in-Extricable; nay the ~~onely such~~ /very difficulty\
as have hitherto bin /and are (according to Mons^r^ le Clerck)\ dispaired of may be
solved
by aid of that Notion, If admitted; ~~w^eh^~~ /And that\ with Me amounts
to a sort of Necessity, /for admitting it\ to be /more\ Explained afterwards
In y^e^ Mean time I Must owne, that this Notion /of devision\ ~~May~~
~~be Styled~~ /or Infinite litleness looks\ p^r^carious, becaus ~~there is~~ /y^e^ termes Imply\
Not an absolute
necessity ~~In termes to admitt it, as there is~~ for /the\ Infi=
nite divisibility /there is\. And hipotheses Not proved May be
denyed. I should Not have ~~Introduced~~ /launched\ Such a one If
I did Not find Naturall knowledg doth /abslutely\ Require it
or Els, It must be layd aside /and without it must be No science at all,\; for ~~that~~ /
phisicall principles\ Cannot ~~have~~
~~principles as~~ /are not like those\ Mathematicall ~~proposition's have of~~ /that is
p^r^cisely stated,\
~~Exquisite certeinty to be Resolved Into~~ /or data\; but /but in phisick\ there Must
and will ~~be some~~ /and strong probabiliys, in many cases, sanctifie y^e^ [precognita?]\ /
be\ latitude, ~~of Conjecture~~, And ~~all the~~
~~phisicoi~~, Even M^r^. N. that phisico-geometer, ~~useth~~ /& all others have\
~~it. And~~ /allowed them\ Cthe ~~Criticisme of y^e^ matter is Referred to~~ /Judgm^t^ is left to
good sence &\
Candor, ~~and Not to~~ /without being suspended as\ Scepticall Cavill; ~~So that If Such~~ /
Therefore\
Cogent probabilitys ~~are p^r^sented as will lay hold~~ /that volens nolens[146] [...?] our\
~~on y^e^~~ assent, ~~It /that\ must in some Measure Comply, but~~ /may be enterteined with a
measure\
~~not with~~ /of\ confidence ~~perhaps~~ /according to y^e^ Nature of\ ~~but as~~ the thing ~~is~~ /as\
/it is more or less.\ problematiq, /accordingly to suspend as\ Inclin/e\~~ation of~~ /o^r^\
opinion. I Should have

a

[146] i.e., 'whether we want it or not'.

x.

a fainter ~~Inclination~~ /disposition\ to this way of proceeding, I Mean
to assume an hypothesis as may be denyed, & I Canno[t?]
prove; If I did Not find all our Naturalists doe y^e^ like
and More Grosly. Aristotles phisicks are all built upon
assumed hypotheses, as that body's are Indued with
a Motive faculty, & y^e^ like. Cartesius makes Great
use of Globules, & particula^e^ Striata^e^. M^r^. Newton of
attractive powers, all w^ch^ are proved alike. And If I
doe Not, by y^e^ use I make of this actuall Infinity, Re=
concile it to a probable sence, So as to Incline a
fair opinion to favour, rather then Reject it, I Miss
my aim.

This Consideration of devisibility, brings the Notion
of continuity of bodys, Sur La tapis.[147] Cartesius hath
a bold thought, Concerning the cohesion of parts, ~~&~~
~~so as to~~ /In\ Compound ~~such~~ /&\ Conglomerate body's /such\ as
are y^e^ ordinary objects of our senses. He say's that
perfect Rest holds them together, w^ch^ M^r^ Newton
say's is, Merum Nihil.[148] Cartesius was so attach't
to his owne way of expression, that I Question whi=
ther he Could /Ever\ have bin p^r^vailed upon to alter, (So
much doth Intens Study engage & hold y^e^ Judgm^t^)
but It seem's as If he might have made more of
his thought, If he had Expres't it another way. that
is, In stead of saying, as he doth, No Glew could hold
body's together More firme then perfect Rest, he had
Sayd, body's Resting together became one & y^e^ Same

for

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[147] i.e, 'on the carpet' (that is, bring it into the discussion).

[148] i.e., 'mere nothing'.

~~84~~ ~~y.~~

ffor Supposing 2. body's to touch, It is hard to
say what difference there is between the union of y^e^
other part's, and those that touch, ffor it will be found
there is Nothing but touch any where to hold things
together. but this will Not doe, for y^e^ Question Ever
Returnes, vis^t^. What holds Even the part's of parts to=
gether? This objection hath No bridle; therefore Mons^r^
le Clerck, lay's aside the whole Matter as demonstra=
bly unsolvable. I thinck y^e^ Case Not so very desperate
but very difficult, and Never to be Resolved with that
certeinty & clearness, as many others are, but there
will Remaine place for argument & dispute. It
will be Enough, If wee can Shew how possibly It May
be, & then wee may venture to say probably it is so.

I must first suppose that Compound body, are Made
of part's subcompound ad Infinitum. That w^ch^ wee see
In larger formes, wee may affirme to fall out in lesser,
and know Not where to stop. There is a sort of Great
Stone Compound of small round pebles, and a sort of
Gravell between, and Some of those pebbles appear to
be Compound of others, & those of sand, & [sic?]. &c. And it
appears by y^e^ cohesion of many thing's, that they Insinu=
ate Into y^e^ pores of Each other, w^ch^ tacks them together,
and is by naturalist's 'titled hamosity. The Reply is
what holds the parts of those clasps or hooks together?
It is returned, other hamosity's; and as often as the
Question is made, the ans^r^ is Ready. Now the Notion of
Actuall Infinity p^r^emised, here are hamosity's, & Subha=
mosity's ad Infinitum, the sume or aggregate of w^ch^

must

z.

Must bring forth a generall cohesion of that lump;
ffor where will you goe to find a loos? There is No part
assignable without hames to coadunite ye parts of that
part. If you say this is an Evasion, is it Not ye Same
In all demonstration's that ~~argu~~ are built upon
ye like reasoning? ~~I grant If an attom be supposed, I~~ /This were sufficient to ansr ye
captious\
~~cannot ansr what holds ye part's of that together, If~~ /Returne of the Question, but
then there are Inconvency's follow\
~~I may be Excused the Impropriety~~ /In other Respects, as Reducing all matter\ almost to
Nothing; there=
fore I hold it but partly, & then this is My hypotheseis

That The matter of the world is In its Nature, Not onely
Extended, but adamantine, & ~~ut~~ unalterable, or as some
say Indiscerpable. ~~And that Conformable to things~~ /And devided or separate In Minute\
~~weh fall under ye Notice of sence, that is Earth, Gravell,~~ /parts or body's,\
~~stones, &cae. I Judg that It is all broken /devided'~~ into very
Small parts; ~~weh is without limitt, or, as I says, Smal=~~ /~~or Individually whereof and
such as the largest is wonderfully by small=~~\
~~ness of Matter is Infinite, and to our Sensation,~~ /~~ness, removed from all sensi
subjection~~\
Whereof the largest are so Small, that Were wee
amongst them, they are all to Subtile for our
Sences to apprehend; perhaps If Magnifyed, as 1/10000.
wee could Not perceiv them. And Judging by what
wee see & feel of Compounds /(what guid Els can be of things of some materiall unseen)
\ wee suppose them ~~of~~
~~all formes &~~ ,(In that Compass,) /of all\ Magnitudes, /& formes\ And ~~both~~ /those\
/both\ Regular & Irregular, cheifly ye latter, ffor ffew things
are Regular by accident, however the approach
may answer it, and wee may be allowed to say
Globular, oval, oblong, triangular square, & ye.
like; for If they are neerer such figures then any other
wee may pass them on account without prjudice. It
May be there is More of Regularity among them then
is here fancyed; but of yt the effect's must Incline ye
opinion, /& that is\ Reserved, to our Consideration of Compounds

~~115~~ ~~aa.~~

Here are divers things to be Considered, ffirst that
of Exquisite hardness; This is an allow^d property
of body, and never to be taken from it, for Every
thing is hard, or May be Made so; The onely Ques=
tion is whither there be degrees in hardness? Wee
have Not Experience of any, ffor all the yeilding
wee know, is from cession of parts, And therefore
the point Cannot be Experimented, but argued
upon probability's onely. therefore wee Say that since
wee have such proof of hardness, and None of any de=
grees of it, wee have No reason to admitt any. and
Next the Cours of things in Nature doe Not Require,
That one thing should be harder then another, becaus
the subdevision of Matter, w^ch makes continuall ces=
sion & succession of body's, accomodates Motion, on W^ch
y^e action of y^e World depends. It seem's that Matter Must
be Either adamantine, or Impalpable. that is; If the
part's will break away upon force, any force should
doe it, & then there Could be No Continuum. If ~~any~~ /some\
force, what? or where should y^e way first break. It is
a comon sophisme, to say, that If a Cord be Equally
strong, No force Could break it; becaus it is Not de=
termined, where y^e Rupture shall fall. And the ans^r
to it is negation of y^e fact, that nothing Extended
& compound of part's can be strong Every where
alike. or Els to Say a sufficient force, (& what is
that?) shall dissolve y^e whole all att once.

ab.

So for the part's of Matter w^{ch} wee say are Not
Compound but Intire & unporous, If a force (sup=
posed) Sufficient to break any, Should fall, It Must
Not be Rupture, but Contusion; the whole Matter
Must be dissolved, & Not broken. for Where Should
It break? It will appear afterwards that a per=
cussion of one body on another, drives the whole
at one Instant, & Not successively, or any part a=
lone. Then If upon a Stroke a part Shall crush,
Into what part's, or how Many? there is No Such
thing in Nature as answer's our Idea, of amalgama
wax or butter, In the Manner of Cession to y^{e}
touch. for that is meerly one part Giving way to
another, as sand, or ashes: and Not Crushing y^{e}
Substance, Nor is any Experiment to be Made of
any ~~st~~ such effect of all y^{e} practick force can be
brought upon any body, but after all it is Resolved
by cession of parts. and No pouder Can be so small
or fine, but a Microscope shew's to be & consist of
compound lumps or congeries of Matter diversly
formed. And what is it Gives to body, of w^{ch} Wee
know Nothing but Extension, its Measure of hard=
ness, so as some shall crush with this, & others
with that degree of force? It Must be a severall
principle, In Every severall body, and heterogene.
what a world of principles will be found, In such
a world of devided Matter?

Therefore the Shortest & plainest principle (&
such

~~116~~ ['b' washed out] ac.

Such are Comonly found the truest.) that the pri=
mary parts /of matter\, ~~a~~ uncompound or unporous body's, are
Indiscerpible by any practick force. And y^e^ frame
of Nature should Crack, as soon as one of them be
broken. for hard wee know, but by what measures
to Qualify or limit it wee doe Not know; therefore
Wee take hardness to be a part of Extension, so
as it is Impregnable; and that degrees of hardness are
No More plausible then degrees of Extension
taking it, In the same Matter & Magnitude. W^ch^
is Nonsence, for Extension admitts No degrees
within its limitts, and So I say, hardness is y^e^ Same
thing and hath No degrees. Extension or body May
be dilated in magnitude /or limits\, but then the Extension
of Every part, as also y^e^ hardness is y^e^ Same; the
Image of degrees of hardness, wee Receiv from our Sence
of yeilding /to\ Impression's; some Compounds being More
so then others; And that is ascribed to cession of
part's, and Not a qualification of hardness. But
that, as Extension, must be absolutely so, In Single
part's, or body's unporous, or Not at all. Therefore I
Conclude that such body's or part's of Matter are
absolutely adamantine & unalterable. And herein
I differ from Cartesius, Who Insinuates, that the Glo=
bules have bin worne Into forme, & that y^e^ Subtile
matter, hath bin knock't off their their corners, and ano=
ther sort formed Into Screws to pass thro the Span=
drill Spaces of y^e^ Globules; all w^ch^ I wholly Reject.

105v

ad.

Then Supposing the part's of Matter unalterable
in themselves, the Question /vis^{t}\, what holds the parts
of those part's together? so apt to Returne, is stopt,
for it is answered that w^{ch} Made them Extended.
And the matter of Continuity will be More readily Re=
Solvable. Many accidents will Concurr to it. 1. figure,
ffor when very Irregular stuff comes together, It is Not
to be wondered it clusters In heaps. for tho there be
Not direct hooks in them, the hollows & prominen=
ces may Interfere Enough, to hinder the Motion, or
separation of them. 2. Rest. I will suppose a parcell
of Cubes close apted together, It is easy to brush off
some at y^{e} Sides, or y^{e} Corners of y^{e} lump, but No Gross
force Can Come at y^{e} Midle to devide them. ~~And al=~~ /or touch one\
~~tho Matter is Supposed Infinitely Small, to supply y^{e}~~ /part without driving many
rather closer a [.....?] wa=\
~~Comon occasion of Motion, yet It may Not Exactly~~ /ter shall lift them asunder, when
hammer's doe but\
~~[to me time?] Every occ~~ /beat them together, And. 3. want of Gravity\ Wee are Not to
look upon
the case of lumps of Minute Composition, as heaps
of Stones in building or otherwise of a Gross Sort
Such as wee handle. ffor those are affected ~~su~~ with
weight ~~that~~ /so as\ Even that tears them one from another,
w^{ch} will Not have that Effect, In Minuteness; ffor
there Gravity is lost; as wee find in water drops such
as compose clouds have Not force to fall; w^{ch} pro=
position is Explained under that head /as also Gravity\ This Makes
a Mighty difference; for it is No wonder that parts
stick together, when they have No weight to Move
them. The whole Shall have full weight & Eff=
fectuall, ~~but~~ /compound of y^{e} weight of all y^{e} parts, yet seperatly\ y^{e} parts are
disabled, as I there shew.

4.

~~117~~ ~~ae.~~

4. The plenitude of the World. this must be allow'd
In Some Sort to Impede, tho it doth Not Supplant
Motion. ffor altho Generally Interstitiall spaces are
Supply'd by small matter even to Infinite. but accidents
May fall so ~~that~~ /as\ Even that may not be. as for Instance
a body Compact with Equall cubes, one that touches
others Exactly, cannot be Moved out, for want of Such
Supply. this difficulty Impeding motion, May conduce to
the holding together bodys that Rest Contiguous, &
make some shapes of Matter, apter to Conglomerate then
others. 5. Touch, It is Not clear but body's touching by
a flatt superfices may become one to all Intents. ffor
It is scarce possible to cast a distinction In y^{e} Substance
In any other part, and as it is at that contact; and then
according to what was sayd of the adamantine Nature
of body, they Could Never be devided againe. but I doe
Not agree to this; but Must suppose, however flatt, If
properly moved, they Must be separate; for as one Can=
not, as I say become two, so as surely, two Cannot be=
come one. But yet such touch Must Egregiously Con=
duce to y^{e} holding thing's together, becaus they cannot
part flatt, & sliding onely. for flatt they Cannot part,
If y^{e} World be full, and wee allow No pores, because the Sub=
tile matter cannot Enter between at y^{e} Sides & Midle
all at once; Some time is Required, for passage from
y^{e} Edg to y^{e} Midle, but y^{e} parting is In an Instant;
This is Not like y^{e} Case of 2. Marbles, w^{ch} y^{e} weight
of y^{e} atmosphere, for a force superior to y^{e} almos=
phere, Shall devide them, and Ether Comes freely
between

af.

between, thro ye pores. but In ye case of unporous
parts touching flatt, nothing of that Can be, and
supposing ye World full, No force can part them flatt
or otherwise then by angular opening, or sliding
aside, becaus there can be, (as wee say), No vacuity.
So doth this /meer\ touch, ~~meerly as such~~, conduce to holding
thing's together. And /In this matter\ Cartesius was wanting to his
owne Method, wch was to Reduce principles to ye
fewest yt Might be, and yet Made Rest a principle
of Cohesion, without giving an acco. why or how.
but he had In his Mind Some farther glimpses, wch
he could Not well, or failed to Express.

The Modernes Especially of the french, with whom
Mr. N. seems to Comply, Make springyness, wch they
Call Elater, or Elasticity,[149] a principle. That Many
body's, Compound as wee know them, are Springy
is apparent by proofs of their yeilding, & Resulting,
but It follow's Not from thence, that originall or un=
porous matter hath any sort of yeilding of the
Substance, & consequently Spring; ~~I deny,~~ And I po=
sitively deny it, as Inconsistent with hardness, &
Impossible. as to hardness Enough is sayd. and as to
ye possibility in other Respects, consider that If
A body stricken yeilds in ye Substance, Either there
is penetration, or the figure of the body Must alter
by ye part's giving way to one & other. the former
will Not be prtended; then ye other way Must take,
and a Globe become an ovall. this must be done
by

[149] *See* note on f. 87r, above.

by the parts protruding some, and sliding by, or
lightly displacing others, So that No one part in y^e^
whole body kept place with Respect to the Rest.
Whereby y^e^ forme of y^e^ whole is altered; and the sides
of y^e^ Globe, at and against y^e^ touch, some neerer
and the alternate sides depart farther from Each
other, Whereby an Elliptick sollid is formed out of
a Globe. Now I would demand of the Witt of man
to tell me what caus there is to Reduce this ovall
Solid ~~bag~~ back againe to a Globular shape. It Can=
not be say'd, the Matter stretcheth, No More then
that it shrinks, and Nothing but dislocation, w^ch^
will demand as active a caus for a Restitution
can give such a forme, as is Necessary to such a Spring.
If they say it is a quality or principle in body w^ch^
hath that Effect; Gratis dictum, No More's to be sayd.
Therefore wee must take it ffor Granted that Sprin=
gyness is the effect of Composition, w^ch^ being a Subject
of great Importance & Nicety in philosofy, I designe
a place Express for declaring the manner of all
springyness In Body's ~~solid~~ /fixt\ or fluid. but I must Needs
observe the authors y^t^ Court this Quality of sprin=
gyness, as Inherent in body, assigne it severall de=
grees, and allow one Extream to be strong as Infi=
nitum, w^ch^ hath y^e^ Strongest Reesult, & In vacuo,
say they , Equall with the movement of y^e^ percussion.
Now if Exquisite hard yeilds consequentially a
Springyness, as they Seem to Grant, what Need of
any

ah.

other Caus or principle to be forged for ye purpose
of it? so that I lay hold of those effects of hard
body as an argument of this adamantine Nature
of body. of wch More will be sayd In ye laws of Mo=
tion.

I Must before I proceed observe, that this hypothesis
of continuity, founded upon Irregularity of Minute
parts, and ye Effect of close Contact, yeilds us an acco
how fluidity Maintaines it ~~ste~~ self, as wee see it doth
In Much ye Greatest part of the world. ffor to Say truth
the Solids wch are onely in & about ye planets, are
like pin's points to ye univers. If body's touch by
points the Contact hath No Manner of force to hold
them together, so also If they are of rounded Shapes
Globes, ovalls, cones, /cilinders\ & ye like. (I mean Not with any
exactness, but Inclining to such shapes, as well as
other's are in ye Same Reason) one hath No hold of
and are small hindrance of Each others movements,
at least Not So Much, as others ~~of~~ /towards\ a Quadrate forme,
And those touch others onely by lines or points, and
So tend Nothing to Continuity. Wch argues fluidity
to consist generally of ye former Sort Whither simple
or Compound parts /& this shews that the Rounder figures have Greatest share in ye
world.\ But yet allowing all /the\ Reason's
to hold thing's together, the action's of [Menstrunery?]
and fire, wch operate [particulatim?], will discerp
or disolve ye hardest Compound wee know.
And when it is fire, ye consequence is fluidity, or
melting, wch is the moving of parts, yt Rested together.

~~119~~ ~~aj~~.

This is What I thought considerable to p[r]emise Con=
cerning the substance of the Corporeall world. I Next
come to consider the alteration's it is subject too,
ffrom whence wee derive all our Ideas, the Creatures
of sence. If body were all one mass, & undevided, It were
like y[e] ptolemaick sphears, or y[e] Celum of Aristotle,[150] a
dull lump of useless substance, But so farr from that
by the divine ordinance, it is /all\ broken into Innumberable
parts, and those held distinguished, by their Motions.
It is hard to say whither the creation of Empty space,
If such may be conceived, or Solid Extension, were
more fruitless, If that devine Invention of separation
had Not bin added. But this Extruded Mass, so dis=
posed, with y[e] adjunct of sensation given to Crea=
tures, produceth that Image [~~...~~?] /of\ beauty as well as
order in y[e] world wee dayly observe, and ever
Invites to Religious Dutys. Considering that a
sensible or ~~a~~rationall creature, dyes when Motion
leavs him; and on y[e] other side y[e] World is almost
all alike, having No Essence Nor variety but what
is Extension, or the consequences of it, without
colour, sound, prospect, or any thing y[t] wee ad=
mire In it self, And yet occasion's in us all these
Glory's; Surely the wisdome of y[e] Creation, is In=
finitely to be Exalted, beyond y[e] vulgar suppo=
sitions, Nay y[e] Suppositions of Many philosofers /w[ch] Rise~~th~~ No higher then\
~~of~~ /y[e]\ performing /~~all~~\ the [seens?] /~~universe~~ of y[e] world's or natures phaenomena\ by
\many & forc't/[151] contrivances as a
small

---

[150] For Ptolomy see above, f. 20r; Aristotle's '*celum*' (properly: *caelum*) is his heaven or sky, a crystalline sphere encompassing a geo-centric system, like Ptolemy's.

[151] 'many & forc't' is set below the line, I am supposing that it fits here - it certainly seems to relate to the word 'contrivances'.

ak.

small mckanick Makes a clock, or any other Machine,
Consisting of divers parts, & multitude of notches, & cava=
tures adapted to Each other, of w^ch^ any one failing
y^e^ Whole designe failes, & y^e^ Mass Returnes, (as to all
such porposes) to its originall Element. All Machine
& Contrivance, Even among us, argues want of power,
and Not the Excellence of humane nature, that ffor
Supply of Wretched Needs, Must find some Extraordinary
way's; but to doe all thing's by Immediate force &
with one act, is surely /[~~...~~?]\ the Caracter of perfection ra=
ther then y^e^ other. Then what an Infinite perfection
doth it Argue, when it is made appear, that onely
one Essence called body, or Extension, (for that is y^e^
onely property wee know of it, & may be its de=
nominator) put Into a Cours of perpetuall chan
ge of place in small parts & devisions, Shall by
No other or farther contrivance, but by Necessary
consequences of that /one\ Essence produce /in ~~the~~ sensitive minds of animals\ all the
varietys
formes, and appearances in y^e^ world.[152] I wonder what
makes men fancy, this opinion to be against Reli=
gion, w^ch^ according to Right reason, as I Judg it doth
most Eminently promote it. or what Need is there &
why should folks strain as they doe, to ~~p^r^vent~~ /~~ob~~ obviate\ the
Expectation ~~of~~ some curious person's ~~of~~ hav/e\~~ing~~ /of gaining\ a Satis=
faction concerning Naturall thing's out of this Corpus=
cular Hypothesis? The case of the ancient's I touched
before; y^e^ world is much changed; Now policy, I would Not
say pia^e^ fraudes,[153] succeed. what Els can be y^e^ Meaning
that y^e^ Ecclesiasticall order, make it a buissness to
batter

[152] Here RN expresses the 'metaphysical' core of his materialism (and of his reading of Cartesian materialism, too). A counter-intuitive (or rather counter-sensual) paradox which has a rhetorical effect not unlike Milton's double-take on Adam and Eve's Expulsion for Paradise as being a '*felix culpa*', or 'fortunate fall'.

[153] i.e., pious fraud (usually 'pia fraus').

~~120~~ ~~al.~~

batter an hypothesis merrely philosofical; as If it were
an heresie. I am sure the Making matter of truth
& falshood In phisicks, to come under theologicall
Governm^t Is superstition or wors. One would wonder
ffor what reason, the greatest Hinter (I speak with=
in Compass) that Ever lived, Cartesius, is fallen upon
and those that doe Not rail Not at him, and fall
out with Irrefragable truth's, becaus founded on his
discovery's, are accounted a pevers sect, that are
deaf to comon sence, as sworne to a master, and
followers onely with a blind faith, & No judgment,
and treated, with y^e civill address, of y^e Cartesians;
Those gentlemen, & y^e like. and one, No Small phi=
losofer in oxford, Shall with a more then tutoreall
arrogance, despise all y^e drops from Cartesius, & scorne
those that thinck y^e pholosoficall world hath Received
great helps from him. And another of Cambridg, Shall
make it his 30 years Study, to Confute Cartesius,
and consequently all his dogmata must be perfect[154]
contradictory's, y^t one thinck's y^e World full, & y^e other
next to Empty. the former thincks that the Rolling
of y^e generall Ether about y^e originall luminary's
(w^ch Must last long Enough,) carry's y^e Secondary ones
y^e planets, as In a silent stream. y^e other will have
them goe on by a vis Impressa In vacuo[155] (& Note y^e
vis Impressa is a discovery of Cartesius,) and are kept
In ~~plaice~~ place, y^t is Elliptick path's, by mutuall attrac=
tion, & for y^t End sets up an Idoll called attraction
supposing

[154] The above five or so lines seem to have been written with the pen pressing so hard that the ink has flowed more heavily than usual, causing slight blotting. It is likely that John Kiell was the academic in Oxford (see note on f. 30r) - it was Newton at Cambridge.

[155] i.e., 'a driving force in a vacuum' - in this section 'the former' was Descartes, 'the latter' Newton. The use of the word 'Idoll' just below is not only a reference to the religious/heresy contexts previously discussed, but also draws in Francis Bacon's metaphors of prejudice (the Idols of the Tribe, the Cave, the Marketplace and the Theatre) set out in his *Novum Organum* of 1620.

am.

Supposing that all body's attract one & other, accor=
ding to Quantity, then w^ch^ Nothing is More fals, & Con=
trary to Experience; for suspend a millstone, and a
pistoll bullet, by long string's will y^e^ bullet draw from
its perpendicular, & cleav to y^e^ Milston? I suppose
none will fancy it. The former had found a solution
of light & Gravity, by y^e^ Recess from y^e^ Center; tho as to
light wee doe Not agree with him, yet have our hints
of what wee doe opine, from him. the Other will have
light Corporeall, tho absolutely a contradiction & Im=
possible. And Gravity must be vis centripeta. the
former found out y^e^ Reason of Rarefaction to be y^e^
parts by motion drive each other Into larger Com=
pass, & smaller supply's y^e^ place, y^e^ other will have ra=
refaction a Quality In y^e^ parts of matter contrary to
attraction, & may be called Recession, that is they flye
/from\ one & other. And In a formed polish't work, declares
his principles all but supposalls, that is vacuity a=
broad in y^e^ world (I wonder how that Should be proved)
The body's attracting one and other; and Some=
times flyng one an other, with certein Measures of
force, and so centripetall & centrifugall forces,
professing to proceed Geometrically upon admission
of those principles, and to have No phisicall Regards
And yet In Conclusion falls to demonstrating other
men's phisicall accounts fals, who If they were
called to answer; would cutt short his process
by

by denying all or Most of his postulata. Nor is this
a fair proceeding, tho he countenances it, by styling
it analitick, as beginning Not with Experiments
but hypotheses. whereof the fallacy is apparent. It
is Easily allowed the best way to argue from Ex=
periments to principles; and Not from principles
to effects, becaus effects may fail. But to call at=
tractive and Separative powers Experim^{ts}, is besides
y^{e} point. for those are hypotheses; for the experim^{t}
is that body's come together, and sometimes separate
but that it is by vertue of any Intrinsick power, ~~or~~ /& Not\
from Comon Impuls, or /Externall\ protrusion, is ~~Not y^{e}~~ Experim^{t}
but ~~the~~ /~~argument~~ inference or,\ hypothesis, built (tho faultily) upon it.
So he proceeds Inverso ordine[156] directly Contrary to
what he professes. But I am too long here upon a
comparison of this author /caprices\ with Cartesius as dogmata,
(tho for Candor & Ingenuity, there is No Comparison)
And proceed to draw these Reflection's to a Conclusion.

I had once an opinion, that is generall and af=
fected swerving from a plaine & Just Method of phi=
losofy, had bin y^{e} Result of humane Infermity,
of w^{ch} it hath bin observed, that When any art
hath bin by ultimate Endeavour's raised to a
pitch, beyond w^{ch} the Greatest witts despair to
advance; they will Not Rest, but rather goe out
of y^{e} Way, & be singular, to appear Extraordinary
and Not but just as wise as other's have bin, And
so languages, painting, &c, when at y^{e} height of
perfection

[156] i.e., 'the wrong way round'.

ao.

perfection, Continually decline, till a New Inclina=
tion to vertue & true Excellences In Some Extraor=
dinary geniuses happen's to Rais them againe.[157] thus
so In philosofy, after ye phisicoi had Subtilized as
far as their witts & Invention would Carry them, comes
Aristotle a transcendent genius, who found No [...?]
was to be gott, by prosecuting the former Methods, Re=
solved to Make a New one of his owne, different
from all ye Rest, wch ~~W~~should be Inveloped In words so
as It should be Impossible regularly to Confute him
for Example, Motion, is the act of an Entity /in potentia\ as it
is in potentia. Wherefore ye ancients were [amused?]
yt went about to Confute him, but ye Modern's & ye
cheif of them Cartesius confuted him uno flatu,[158]
by Saying, Nothing was understood of Nature out
of his phisicks, & they were useless, If Not pernicious
to all philosofy. however after ye Revivall of lear=
ning, that Method prvailed, as being More adapt
to ye disputing humour of ye Scools; Who In Religion
also, would Entertein No dogmata, wch Would Not
bear Everlasting wrangle. Then came in those great
light and as lovers of truth, with an honest heroick
Intention, to bring ye vertuous part of Mankind out
of darkness Into light, Exposed the vanity and In=
sensibility of the Scools, & the founder Aristotle, In his
work's concerning Naturall thing's. And threw aside
ye Rubbish of Quality's & Quiddity's, layd open the
very Essences according to our clear & distinct
perception of them, owning Nothing doubdtfull; but
on ye

[157] This is a remarkably similar conclusion to that of contemporary art historians. Vasari expressed anxiety of this happening afer the death of Michelangelo; RN's contemporary, Bellori, introduced the notion of a degeneration of art through the imitation of masters rather than the imitation of nature (its negative corrolary was a slavish submission to nature). Although, such a view of the inevitable decline of an art or discipline is a commonplace, it does little harm to imagine that it might have been learned (or reinforced) in discussions in the studio of his friend Peter Lely.

[158] i.e., 'in one breath'.

~~122~~ ~~ap~~

on y^e^ other side, to Make sure of some things, at
first doubdted all things. And aimed at demonstration
upon as clear principles, as the Mathematictians use;
This Reformation must needs be Well accepted, as it
was by y^e^ Ingenuous and disinterested; but y^e^ faction
ag^t^ it hath bin touch't & is Not unknowne. however
The vertuosi proceeded on that foot, & Courted
Experiments, Even to another Extream, as our
Royall Society's Motto, Nullius In verba,[159] testifyes.
But after all this, the aforesaid Author is to Start up,
with Geometry upon his Sheild, and fights for a Res=
tauration of the So justly deposed Quality's. this
I Say once I thought was meerly an humour, of
Seeking fame and p^r^eference, More then truth. But of
late I find, and am therein guided by the Excellent
ability's of y^e^ person's; that all is a Meer Confederacy
to depose Not onely the plain principles of philoso=
fy that Cartesius useth, but Indeed all Naturall
philosofy, and to Reduce all Speculation to the
Compass of Geometry; And there Men are Encouraged
to Expatiate as they pleas. And this I beleev may be
done /by many sincerly, as they struck\ for y^e^ Improvem^t^ of Religion, and out of an
opinion that philosofy leads Men to Atheisme. then
w^ch^ In My opinion Nothing is More fals; and they Must
Not thinck as I doe, If they Can conceiv y^e^ Mun=
dane Systeme without adoring. But perhaps It May
Make men a litle too Inquisitive ~~apo~~ about Autho=
rity's & power, and Not yeild so ready a Consent
to some mens Insinuation's, w^ch^ they see tend onely
to

[159] i.e., 'do not accept words', 'take no one's word for it'.

aq.

to aggrandise themselves. And therefore Ignorance
of Nature things, makes way for Supernaturall p^r=
tensions. one great reason of this Jealousy of Mine
is the Notorious practise of the Roman Hierarchy w^ch
will let No New philosofy (as it is Called) be Read
Nor by their good will privately studyed; & they have
gone a great way, Where they have power, towards
wholly suppressing it, and some amongst us, Inclined
to y^e other Extream are practising y^e Same thing.[160]

Now to end this digression, & Returne to Consider y^e
changes & variety's body is capable of, so as to fur=
nish our perception, with such Multitudes of very diffe=
rent phantasmata, I note first that No change can
happen that is Inconsistent with y^e Extended Nature
of body, that is of More or less substance, conteined
in limits of any one part. This is Called penetra=
tion of demension's, and Nothing more generally
disowned, Nor More constantly proved, by the Never va=
rying experience of things. But then, Consistent With
Extension; body is capable onely of these varietys.
1. figure. 2. posture, 3. distance, All w^ch fall under
the like Estimate as body it self, that is Exten=
sion. for 1. figure is the Extension of y^e parts one
way & other, some more & other's less Remote from
any comon point or Center. 2. posture, is When
Some part's of a body /Respect or Not Respect or\ are neerer or farther /Removed\ from
others. 3. distance, is Measured by body, or Extension
y^t may Interpose between one body and another.

place is posture & distance[161]

---

[160] RN implies that Newton was in some way associated with the extreme of 'free-thinking' protestantism (and even Republicanism, or at least the pragmatic revision of true kingship); in RN's demonology this position provided an corresponding error to that of the other extreme of Roman Catholic scholasticism.

[161] This is written in a tiny hand at the very bottom of the page, as shown. RN occasionally inserts notes and memos in this fashion.

~~123~~ ~~ar~~.

I might here have spoke of magnitude, & place; y^e^
former hath bin discourst, but In Regard I account body
In its primary parts, unalterable by Increas ~~or~~ deminu=
tion, or devision. I put it Not among y^e^ changes body
admitts. 2. place, cannot better be Explained then
by y^e^ very word, w^ch^ children understand; and If I went
about as Many doe by going, as they say, between y^e^
paring & y^e^ apple /to make a ~~to~~ description of it\. I must draw it out of y^e^ former
thre, figure, posture /&\ distance. ffor /y^e^\ place /one body\ must be Mar=
ked with Respect to certein others, there being as, I
sayd, Nothing of here & there absolutely, and /as\ for dis=
tinguishing between y^e^ body & y^e^ Room it fills, I have No
disposition to such Nicetys.

1. figure Respects Either one bod[y][162] alone & y^e^ parts of it
as was described or it may R[e?]spect divers body's, &
that Whither continguous. or Not; As to the parts of
Every body and the disposition of them with Respect
to Each other, composing y^e^ figure; It is well knowne
how it may vary, In some Rotund, in others, Quadrat
triangular, & y^e^ like with degrees ad Infinitum. And
there Must be some one point, In position Neerer
a true center then any other. w^ch^ is called y^e^ Center
of Gravity, & for brevity center onely. The circular
and Sphear or Globe, are defined by equality of
all lines from y^e^ center to the Circumference. but
/in\ other figures, some uniforme as Quadrates, oblongs,
& y^e^ like, the lines are Not Equally but uniformely
distant from the center, that is when a plane
devides

[162] There are two small holes in the page here (and in the corresponding position overleaf … of course).

as.

devides the body thro y^e center, Equall parts with
Equall distances & Respects from y^e Center, are found.
But when body's are very Irregular, perhaps that
Cannot be, and then wee set Quantity ag^t distance
& Make an Equality, as will be shewed, In the few
proposition's I have of y^e ~~Eternall~~ Irrefragable rules
of Motion. That such a point is In Every body, I thinck
will Not be disputed. as let AB. be y^e body that
<diagram> Hath More Quantity towards A. then
towards B. So as. 2. to. 1. ~~then~~ w^{ch}
Quantity I Expose by y^e points ~~d~~. &. e.
then on y^e other side is only y^e Quantity. B. w^{ch}
is 1/2. d+e. then the distance of B. from y^e point. C.
is to that of d. &. e. as. 2. to 1. then the propor=
tion is. As Qu[an]tity. d+e. to. Quantity. B. so is
distance B.C. to distance d. or e. y^t is A.C. then
C. is y^e Center. Here is a knowne proportion, vis^t 1/2.
but perhaps on other sides of the point. C. (for a
solid Extends Every way, of w^{ch}. A.B. is but one)
there may be a different proportion that Shall
Not fall Exact according to this Equation. then I
ans^r, move y^e point. C. so that by gaining one Way
and loosing another, It shall be placed, as Neer
an Equation Every way as may be, then I Say
that will be still y^e Center, and who will know
y^e methods of Calculating this may Study Wallis
de Calculo Centri Gravitatis.[163] But one thing I
must note, that however I shall use, In diagram
lines

[163] John Wallis (1616-1703). These appeared first in *Phil. Trans.*, No. 43, 1668-9, and in chapters IV and V of Wallis's *Mechanica: sive, de motu, tractatus geometricus*, London, 1670.

lines /& linear figures\ as the plainest description, yet I shall mean
Solids and planes. as here the lines Ac. & C.B.
are Supposed planes. And when I suppose a body
bisected thro y^e Center of Gravity, It is meant by
planes, and that y^e Equation, is between one side
of the plane and another. before I leav this I Must
Note, that it is Not Necessary, the center of a body
fall within y^e Substanc of it, but any Where Els
according to y^e forme, be it annular or otherwise
curve, & Irregular. And then Where [ye?] /[&?] center-\ plane cutts
the body, It marks In y^e Superficies a line, y^e Center
of w^{ch} line, In y^e Same Manner Estimated, hath y^e
place of y^e center. w^{ch} to Render less Confused let
us suppose it, to be a point on y^e Superficies, ~~In~~ /thro\
w^{ch} /and thro y^e center\ all planes Intersecting one & other devide y^e body
according to y^e former Equation. W^{ch} point upon y^e
body Some, Call y^e Center of Gravity, becaus the body
May be susteined upon it, with out Inclining
any way by force of its weight, y^t is in Equilibrio.
as may be found among wrighters of staticks.

<diagram> let. A.B. be an Irregular body of w^{ch}
C. is the Center of Gravity. let the line
C.D. (w^{ch} in staticks is y^e perpendicu=
lar, bisect the body, according to y^e for
mer equation, y^t is so as distance from c. and solidity
on Either is taken in /cross\ proportion, makes an Equality,
I say (drawing 2. paralells. A.F. &. B.G.) the Equi=
librium will be at E. And Every plane, that Intersects in
the line. C.D. will bisect y^e body according to y^e Same
Equation.

au

Equation, and the distance E.A. and E.B. that is from
ye paralells on Either side, touching ye ut most parts
of ye body, are to Each other, as ye substance or Soli=
dity on each side. so that as. E.A. :: EB, distance
so B.G.E. :: E.A.F. solidity. This is a difficult
proposition to demonstrate, becaus Every Irregular
figure is a severall proposition. But I Ground ye Con=
clusion on this; that If ye same equation happens Not
Every way ye point E, & line D.E. must be Moved Some=
What to meet with it, wch considering matter or Space
is devisible in Infinitum, may be so ~~plast~~ plac't, as
to produce ye Same Equation on Every side, and let
any point of ye body be Called ye point. E. or D.
In Regular's there will be small scruple, and for ye
Rest, whither it be here or there, If there be any
point More Indifferently posited with Respect to all
ye parts, ~~with~~ setting quantity agt distance and the
Contrary, that point is the Center, and that there is
such a point attends every body In ye World, I thinck
there is No reason to doubdt. Now I must here distin=
guish to prvent Confusion, that ye center of ye body
and ye Center of Gravity May Not be ye Same in
Some men's sence. for If an heavy body. B.A.G.F.
Equilibrates upon ye point E. that is a Center of
Gravity, so If suspended at. D. but ye Center of the
body is at. C. And such a Center of Gravity May
be Every point of the surface, but ye center of
ye body. C. is allwais ye Same. Nor doth the des=
criptio

~~125~~ ~~aw~~

=cription hold, vis^{t}. that y^{e} Center of Gravity is
y^{t} point in y^{e} body, at w^{ch} the body suspended, Every
way Equilibrates, for there may be no such point in
y^{e} limits of y^{e} body; but within or without there is
allwais some point or other, by w^{ch}, (supposing an
(Imaginary) union) y^{e} body propt or suspended, would
Every way Equilibrate. I would be Nice about y^{e} Notion
of this center, (for I shall Mean No other, tho I say
center of Gravity) becaus much will depend upon it,
& this is all I shall say of [~~.~~?]figure, Respecting the
part's of one body onely.

2. As to figure Respecting divers body's or parts, If
they be Contiguous and Cohere, w^{ch} is y^{e} Case of our or=
dinary Compounds or Continuums, They fall under y^{e}
Consideration of y^{e} former paragraff, as one Single body
to all Intents. If they doe Not Cohere /but Move\ y^{e} Case is y^{e} Same
to Most porposes, as If separated; and the porpose y^{t}
destinguisheth Is Not of this place. But supposing
them separate /or being contiguous unconnected\ then the figure is Compound of Each
part, and of all taken together. But here No one is
any Connected with y^{e} other, and If one be disturbed, y^{e}
other are free, w^{ch} is Not so in case of single bodys,
for of them No one part is passive but ~~it S~~ all are
So together. then of separate body's y^{e} figure is
perpetuall and Infineitely variable in chang, for
It may be wrought, by one more, all, & each by
Infinite various manners. So as the/is\ Comon figure
of y^{e} whole shall be changed, but Nothing Els.
now

ax.

Now those who have thought ffitt to Connect separate
body's by certein mutually attracting forces, (A Chimera
ffitter for y^e^ Moon, then our Sensible world) have found
it Necessary to ~~find~~ /obtein\ a center, Not by my measures of
distance, & solidity Counter proportioned, but Consi=
dering y^e^ attractive forces deminish as y^e^ squares of
y^e^ distances, there is some point In w^ch^ all y^e^ solidity
would concentrate, If y^e^ attraction carryed it thro, & /there\
~~that~~ (I thinck) is their ~~s~~center of Gravity (as they
Improperly Call it.) fixt. [~~.~~?] <space left> till I find some what
more then Imaginary, to Connect separate bodys I
Shall have No Occasion to Concenter them at all.
And whenever it is that center's are to be found, it
Must be onely where y^e^ body's are materially Con=
nected, as In Statick's, of w^ch^ M^r^. pardies, has made Some
use. And I shall have No other Regards here, but to y^e^
comon forme or disposition, as they are p^r^sented to y^e^
understanding, of Divers body's separated from Each
other, & this is all I shall say of figure.

2. posture, Is ~~a part of the figure of diver's body's~~ /of one body but with Respect
some others\, whi=
ther cohering, contiguous or separate; and It means
the parts that Respect Each other. As a globe
may maintaine y^e^ comon figure, and yet Chang
y^e^ posture Continually as one side is Now obverted
to another, and anon averted; If y^e^ body be Irregu=
lar, or unequally Extended, the comon figure is
also changed as well as y^e^ posture. This Idea of
posture as well as that of place vanisheth with abs=
traction of all other thing's in y^e^ World. ffor one Single
thing

~~126~~ ~~ay~~

~~ffor~~ thing hath No place Nor posture but with Respect
to Some other, w^ch^ In Comon thincking is the person
that thincks, & Makes himself Not onely a Spectator
but a party In all these Images of alteration. How
far Measure of Space is concerned in this Notion of
posture, will fall in with y^e^ Next paragraff.

3. Distance. The Notion of Extension, and of More and
less are coincident, & y^e^ Same, for those of 1/2. 1/4. &c. &
all subdevisions are Included, so also body is the Mea=
sure of it self, having all proportion's Included In its
Extension. And as it is Equall to it self, another May
be Equall to it, so More or less. And by a Mentall ap=
plication of body to a supposed space, the account of
distance is taken. therefor from Every point, to Every
other point, there is a stated distance, W^ch^ Considered
Every way, compose the comon figure of diver's body's
and partly y^e^ posture of them, (for distance [~~as~~of?] y^e^ parts
as well as Respects, vary In alteration of position)

I might with good warrant have spared this devisi=
on of chang, and left out, figure, & posture; & taken
onely distance, W^ch^ might have served y^e^ turne. but Wee
have such free use of words, that different Names seem
for y^t^ reason different thing's, & with that for clearness,
wee Comply a litle. But this I affirme positively that
Body's of stated Magnitudes, are Capable of No Chang
In any sort or Manner whatsoever, but of Distance
onely, And that chang, and Nothing Els is Mot<u>ion</u>.
<flourish underline>

az.

Now here wee come into ye bryars, being in the land
of prjudice, /from wch\ I know Not one person, author Nor philoso=
fer, tollerably free; but all, more or less, have fallen Into
the plowman's notion, that what moves is (quasi)
alive, & what lys still is, as it were dead. that is as=
signing somewhat /of\ positive essence to Motion, as sub=
sisting In ye Movent; or at least some difference between
a body moving and Resting, Intrinsically Considered;
for who doth Not thinck the bullet that Comes roa=
ring out of a canon's mouth, In a condition farr
other then, those that lye Quietly by? Cartesius him=
Self, who opened the way, and to whom is owing
all ye Justice wee have of thincking about Motion,
It seem's had Not thought Enough of it himself,
but Must talk of laws of Motion, & so others af=
ter him, and then of motion passing, from one
body to another, & ye like. yet to give him his
due he fairest defined motion to be the transla=
tion of body's from the vicinity of some to the
vicinity of others, taken as Resting. And he also
must ascribe a positive force to Rest, wch Mr. N.
after, (tho with litle thancks to) him, Calls vis
Inertiae. all wch might, as some such way of Spea=
king Must, be endured, for Explication sake, after
once the true Judgm't of the thing is declared; It
being almost Necessary to use ordinary Speech
tho In Extraordinary subjects. but Mr Newton, hath
distinguished in his Notion of loco movemt so as
wee Cannot agree with him; for he will have
such

116r[164]

~~127~~ ~~ba~~

such a thing /to be\ as Motion absolute, that is Supposin[g?]
but one onely body In vacuo Infinito, that body
Might be sayd to be Moving or Resting, Without
Relation to anything ~~up~~ Els; W^ch^ is /all\ of y^e^ Same peice
with his absolute place, & time. for all w^ch^ I
know he will have y^e^ shallow philosofick Rab=
ble with him, (and a man is surely a Doctor
that jumps with them), So as I cannot but Won=
der one of his depth of thought, and that Can
accise Cartesius of making reasons of meer
Nothings, should pitch on such Shaddows as
have No essence, but In humane defect, and
p^r^judice. Now I know much Must be expected to
come after this censure, w^ch^ I engage shall be
pure & honest thoughts and as much devest of
p^r^judice or (In some men's language) Nothing=
ness as I can, Conceiving y^e^ whole fabrick of
Naturall philosofy to depend on a just Judgm^t^
of loco-movement, and that therefore it ought
to be weighed & deliverd pure & defecate as
possibly may be; Therefore I say that

Motion[165] is onely the chang of the figure po=
sition, or distance of divers body's of stated
Magnitudes, with Respect to Each other. This
~~Str~~ small description (for I am No /strickt\ logicall de=
finer) affords much subject of discours, to Recon=
cile it to ordinary apprehension; I doubdt Not
but it will appear true, but many [witt?] not
thinck there is truth Enough. therefore I first
observe

[164] There is a small patch of damp-marked paper at the bottom of this and the following folios, … and five worm holes which are not apparent on the following folio.

[165] The word 'motion' appears to have been written in a larger script, it would seem for emphasis.

bb.

observe, that Motion consisting onely in chang
Relative to others, without other body's supposed,
~~of is~~ considered correlatively, there is No Motion.
It was Noted and /must\ here /be\ Remembered that, In our
ordinary thincking wee putt ourselves, In y^e^ post
of y^e^ correlative, and so determine of Motion
as chang happens with Respect to our owne body's
And ~~when~~ I shall Comply so farr, as When I speak
of y^e^ Motion of one solitary body, I shall ~~Re~~ Mean
with Respect to our Station, as If wee stood to-
gether to Regard it, & what happened to or from
it. 2. That when such changes happen, w^ch^ produce
the Idea of motion, It may begin or End, as Seems
In any of the body's Regarded, but y^e^ Motion at
Rest cannot be ascribed to Either; And to say
that this or that moves is (In stricktness) an
Insensible speech, or that w^ch^ hath Nothing in
y^e^ Nature of the things to ans^r^ it, but the true E=
nunciation, that there is some chang between
such & such body's. In figure posture or distance.
So it is Equally true, to say this changes with
that, as that changes with this, as to say this
moves & that Rests, for y^e^ chang is betwixt both
and In Neither; As If 3. body's lye in a triangle
suppose it Equilaterall, and one part is varyed
from y^e^ other two, so as to make it an Iscosceles
or a scalene; It is Equally proper to say, the one
as the 2. Rested, and y^e^ other moved, ffor y^e^ Conse=
quence is y^e^ Same, Nor is it true to say Either
but onely

~~128~~ ~~be~~

but onely that the figure & distance is changed,
And tho In consequence of thing's, the Caus of Such
chang may by accident falling upon or other,
that makes nothing ag^{t} me, for even that is as
vagrant a supposall; for if it is Not determined
whether that caus be motion, or Rest; and It
may, as comonly understood be either. ffor If y^{e}
whole triangule moves, w^{ch} is Judged by somewhat
besides y^{e} triangle, then an obstacle, makes or is
y^{e} Caus of y^{e} Chang, as well as a Movent, supposing
y^{e} triangule lay still; In w^{ch} language I Comply
with y^{e} vulgar; ffor In truth, all thing's In y^{e} World
May be judged to Move or Rest arbitrarily,
As Regard is had to one thing or another, So as
to Collate & Compare them In Systeme, as having
Some Comon figure /and for that very reason It is In Neither\. doe Not wee all know
that
y^{e} book's upon shelves In My library are at Rest
and yet (Respect y^{e} Sun) they Move in y^{e} diurnall
cours, and (Respect y^{e} Starr's /fixed (to goe no further)\ they move againe in
y^{e} annuall orbit? /and so may 10000 other ways\ Whereby wee give and take No=
tion as we pleas, w^{ch} I thinck argues Enough that
there is No essence In Motion ascribed to this or
that body, but the essence ly's In y^{e} dementions
of /divers\ body's Respecting the /comon figure &\ distances betwixt them.

Hence it follows, that if one, Nay y^{e} least parti=
cle of matter in y^{e} world Moves, there is No rest
in y^{e} univers; If I may so speak. ffor the thing itself
is chang, w^{ch} Resides in each part, & Not in Either.
ffor y^{e} very Idea must equally concerne both.

bd.

and as many different Relation's as may be made
of divers body's In Systeme, one to another, and so
those systemes to other's, or other systemes over all
ye whole univers, so Many severall sort's of Motions
or Rests, wee may pleas to pronounce Reigning a=
mongst them. The planets vary from ye fixt stars,
In Each planet ye parts (as In our's being ye Earth)
vary with Each other, as Rivers, shipps, walking
Riding, flying; besides ye More Minute agitations
of matter, by wch wee perceive, as light, sound,
heat, cold, &c. and this all over ye whole univers
so that one May say Every thing Moves & Rest's
Innumerable way's; ye Same of wch is onely, that
The comon figure of ye universall matter of ye
World, with Regard to postures & distances, is E=
ver changing, whereof some parts /or systeme\ Retein the
mutull Respect's, and those are say'd to Rest, tho
the totum In other Respect's is sayd to Move
In wch speculation travelling ye Mind about the
visible world, soon branches into Infinity & is
lost. And this truth will Ever hold, that If there be
any ye least Motion (I must use ye Comon terme
for brevity) In the world, there is No Rest at all.

That wch Creates in us the Ideas of ordinary Motion
and Rest, is partly a sence of our powers; and par=
tly prjudice. first as to our powers, wee perceiv things
bruis us, by Impressing our flesh, and wee would Resist
so wee apply our powers in placing & displacing &
the like, wch creat's In our ~~Idea~~ /minds\ an Idea such
as

~~129~~ ~~be~~

as Wee have of loco-motion; then for p^{r}judice it
is so Egregious, that our certein knowledg, will scarce
lett us get y^{e} better of it. our comon Experience is, y^{t}
some things move with litle force, or by ordinary
means, and that others, not without some what
Extraordinary. hence If wee chang ~~place~~ /our distance or posture\ with
any thing that is vastly Greater then o^{r}selves,
wee conclude it is our selves that move & Not
that; so y^{e} Contrary. As being in a small whery
at Anchor, and A great vessell passeth In y^{e} Stream
by us, wee Conclude wee move & Not that. So
when, In a shipp, y^{e} Crew is weighing Anchor, &
Hales y^{e} ship upon y^{e} Cable, that Gather's In at y^{e}
Haus, by how Much y^{e} vessel is drawne nearer her
anchor. one Standing by cannot but thinck the
cable comes Into y^{e} vessell, & Not that y^{e} vessel
comes on upon that. And Nothing is more Gross then
y^{e} Same Experimented in a windmill. Stand In
y^{e} lower Room, when y^{e} Mill is turned round upon
y^{e} post, w^{ch} stands In y^{e} Midle. and It is Not Easy to
perswade one, that is is ~~Not~~ y^{e} Mill y^{t} turnes, &
Not y^{e} post. for they verily beleev y^{e} latter. ffor
they see often thing's turne within houses, but sel=
dome or Never houses about any thing. And the
walls of y^{e} place, argue weight solidity, & fixation
In Comon opinion, w^{ch} Makes it Easyer to give
y^{e} Motion to y^{e} lesser then to y^{e} Greater. Even y^{e}
Motion of y^{e} Earth, is a Notion y^{t} labours under
this very p^{r}judice; ffor wee live upon y^{e} Earth

& it

bf

/& it\ looks bigg & heavy, Not apt to Move as wee take it,
but wee are So farr from y^e^ Starrs, y^t^ they seem
Small & light. that they chang position with
us is agreed on all sides; but wee cannot thinck
wee turne, becaus wee perceiv by a Constant con=
tinuance of y^e^ Same posture of things about us, that
wee Stand Still. Another p^r^judice is, that When any
one chang is y^e^ Caus of another chang. wee thinck
the Effect is wrought, as wee work; y^t^ is with paine
or rather Intention of force, & strength. And So
When diver's changes of postures and distances,
according to accident, clash & produce others, wee
look upon it, as /upon\ men In a hudle croud, or at play
or fighting, of w^ch^ y^e^ Jostling is action on one Side
and passion on y^e^ other. And thus by our ~~feep~~ feeble
apprehension's, w^ch^ are so full of Error, wee determine
of the state of Nature; and No Wonder, If wee
have so litle Justice In our Minds of Naturall
things, and are so zealous In Maintaining
our opinions, & pervicacious ag^t^ any Regulation
of them, Since few or None truely dispose themselves
to Lay aside p^r^judice.

Having thus given as well as I can a Just description
of what motion is, wee are Next to Consider, how it
[it?]. ffor as motion is but a mode w^ch^ relates to di=
vers body's, so that mode hath submodes as Infi=
nitum. But first In generall.

Matter as hath bin touched is capable, of all y^e^
modes & variation's possible to be thought off, Con=
sistent with the Impenetrability of it. Therefore wee
may

may freely Contrive all y^e^ changes In Nature, &
body will Receive them, with salvo to[166] its essence
that is holding its bounds & limitts. So as all the old
disputes of Motion's being contrary one to another,
(w^ch^ Cartesius takes off by saying motion is Not
contrary to Motion, but Motion to Rest W^ch^ is as wide
from y^e^ Mark, as y^e^ Rest) so as divers opposite Mo=
vem^ts^ cannot subsist In eadem Corpore,[167] & y^e^ like
w^ch^ all vanisheth as soon as it is /(& hath bin)\ alledged that
Motion is Not in y^e^ body, but In the Respective
position, that is Not in but between them. And the
same body is capable of Infinite severall motion's to &
fro, this way and that way, without any Inconsistence
or contradiction, as It hath Infinitely various Regards
to other body's, & Systemes of body's In y^e^ World. And why
Should this seem strang, when the body hath No al=
teration Intrinsically from Moving or Not Moving.
This is a way of thincking of Motion, as it were half
way, that wee find In Most writters, Every One hath
some litle others more, but None throly Conceives
or Expresseth it. And If it be once understood how
absolutely Necessary it is, In the Science of Nature,
without w^ch^ scarce any one Complex action Can be
understood or made seem possible, It will Not be
denyed however paradoxicall, that body's have
Infinite severall motions, at one & y^e^ Same time.

As to Modes of Motion, or body's y^t^ appear to
chang position with others; 1. Swiftness, 2. direction,
The Swiftness is Measured, as Quantity, by Comparison,
as

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[166] i.e., 'saving', that is 'as long as they do not alter its essence ...', etc..

[167] 1.e., 'in the same body'.

bh.

as take any two Motion's, and Compare y^e Spaces, the
difference /of those on Each part\ run In y^e Same time, is y^e difference of their
swiftness, Either in More less, or as it May happen E=
quall. from these Comparison's, wee take our Idea
of time; for y^e Moments are distinguished by Continu=
all New positions of thing's, by w^{ch} duration is Noted.
But If No chang happened among Extended beings there
were No time; as it is with those who sleep, or amuse,
they beleev time hath past, but for want of observ=
tion of differences, felt None. But there is difference be=
tween our sence of Motion and of time. for Motion is
a Continuall flowing; but time is Compound of many
small pulses; and accounted by periods or coincidences
of motion, as days, hours; &c. according to y^e Revolu=
tion's noted in y^e Suns cours, clocks, & y^e like. And altho
wee have an Idea, as If time flowed as ~~most~~ motion
doth; yet I thinck there is reason to suppose it made
up of pulses or points, but Indistinguishably swift.
for sence of time, is Noting of different things; the act
of sensation, that subsists In observing one occurr=
ence from another by its difference. And If you Could
suppose a moment, as also any duration, In w^{ch}
there is No sence of diversity, It is hard to put that
Intervall Into acc^o, of time. And that is the Case of
$amusem^{ts}$ & trances; And time being comparison of
movements, & those measured by Extension or space,
small creatures thinck time longer, then larger
as wee May Remember, when children, day's &
years

~~181~~ ~~bi.~~

years seemed Not so long as when wee grew up
becaus then our stature, was small, & that made all
other (according to proportion) /measures\ seem greater, so it
is very strong, as In paine; the time seem's long. but
when pleased, our attention is less, & then time is shorter.
But however our opinion of duration is, (for Most
assuredly In our apprehension, without Resort to o=
ther things without us /time hath No certein accº.\) the~~re is No~~ Measure/s\ of Com=
pared Motions is certein. as when a space is ~~past~~ /[run]\
~~over, so~~ all yᵉ fraction's of it, ~~as is~~ /are\ Measured by the
~~Spaces themselves~~ stated parts of yᵉ whole, Called halfs
Quarters &c. so that Nothing is measurable in Space
but yᵉ Same is In time, and time & Space may be
Sayd to be but one Extension; And accordingly as spaces
So are velocity's, & time doth but Cutt out yᵉ length's.

2. The other Mode of Motion is Direction, that is
yᵉ Manner how spaces are Inlarged /or contracted\ by Motion. ffor
In the Instance of a system of 3. body's in a try=
angle. The space between one, and one other, be=
comes shorter, but the latter & yᵉ third hold same
aspect or position & distance. this may be by yᵉ
supposed translation of yᵉ 2. together or yᵉ one
Single, or of both, as you shall pleas to Regard
other body's, wᶜʰ may declare all or but this or
that to move. Nothing is certein but that the
Intervening Space becomes shorter; and that is
the line of direction. And If the Caus of the Chang
fall

bk

fall/ing\ upon y^e one, (as supposing some competent
force ~~make~~ affecting that onely,) Makes the space
Shorten, then that body is say'd to Move, and the
line between [on?] body & y^e other is y^e line of its
Direction. And directions May be In straits or Curves
or continue in Regularity or deviate as cases Re=
quire, of w^ch in their place, but generally for re=
Son's to be given, by y^e word direction wee shall Mea[n?]
that line, w^ch is y^e path of a Moving body, and ordi=
narily strait; and there it is to be Considered, that
The same body, May be mentally distinguished
Into part's, w^ch may have Each a severall direc[=?]
tion, as when y^e posture changes, by turning, as
well as distance of the whole, Then y^e direction is
accounted by that line, w^ch is y^e path of y^e Center,
and May afterwards appear Never to swerve, but
move in a strait line, unless confined, by being Made
part of another body.

Now it May be asked, how motion, that is Change
of position & distances of body's in y^e World, first began
and how it Continues. The ans^r to ~~y^e former~~ /this\ is owing
to Cartesius, that Introduced first y^e axiom, that
thing's will continue in their state, till altered by
some Caus, & then Supposeth y^e Same Almightyness
that created this Extended world Gave it that Cours
of Continuall change wrought in y^e Most Minute
parts of it; w^ch once begun Must Continue till Cau=
sably altered. to w^ch this onely is to be added, that
motion Is in No sort a strang thing, so long as

do

~~132~~ ~~bL.~~

doth Not temerate penetration, ffor I proposed for
an universall rule, w^ch I know Not Infringed by any
observation, that body admitts all manner of States
and Condition's with Respect to others, till penetration
clasheth. And when that happens wee must conclude
that when body's approach /In any certein direction\ they will continue so
to approach; /and If never touch part in y^e same manner\ but If y^e direction line Cutts
Each so
that they must touch, then it is Impossible that
Direction Should Continue. And Some alteration
Must happen; And thence I conceiv It is Not So
Much the Motion as the direction, w^ch Makes the
Inconsistency, changeth, ffor y^e Motion is Nothing
in y^e body, but y^e direction of y^e approach, is as cer=
tein as the body;s are Extended.

But before wee advance, wee must a litle adjust
our language. When wee consider of moving bodys
wee Comonly bring upon y^e Stage. 3. whereof two
are y^e actor's and a. 3^d. w^ch is our owne, y^e spectator.
and allwais supposed Resting; that is keeping
positure and distance from all the part's of the
theater, where these games are played. ffor as Mo=
tion is y^e Chang, so Rest is y^e Continuance, as you
pleas to give it Regards & Nothing Els. There ac=
cording to this project, the motion is assigned to
these. 2. body's under observation, according as
they chang or continue place with Respect to
our Selves. If one changes & the other Not, then
y^e former Moves, & y^e other Rests, If both chang,
then

bm.

then both Move, all w^ch^ Must be Remembered to be
arbitrarily spoken, and taking other Regards, that
w^ch^ Moves may Rest, & y^e^ Contrary; but wee must at
p^r^sent suppose and speak as it one moved or both
as shall happen, to our thinking, and is comonly
is done, How ever y^e^ matter I stricktly to be Judged at
larg, w^ch^ wee allwais Reserve.

Next it is reasonable to take notice of some hypo=
theses Some have used, In order to setle y^e^ laws &
Rules of motion, It may be less plausible In Judgm'^t^
then in termes. As that body in it self is Indiffe=
rent to Move or to Rest, that is, it is Indifferent
to Nothing, or w^ch^ is y^e^ Same, what concernes it Not.
for what is it to one body, whither another is Nee=
rer or farther off, thus, or so posited; & what as=
pect it bears? This is [bilk?] and all that is argued
from it, is built upon Nothing. Then a difference
is made between Motion In vacuo, and In pleno
so that various law & rules are priscribed In y^e^
former, not Injoyned in y^e^ latter. as M^r^. pardies
say's, the least body shall move the greatest body
in vacuo with Equall swiftness, why? becaus it
is Indifferent to Move or Rest, ergo. &c. these are
words. as to vacuum. If such a thing were, the
onely difference to be made, twixt that & plenum
as to motion; is that In the later More body's
then that in view are concerned. for If a body
be moved In a fluid as air, &c. It carry's before
and behind according to y^e^ Swiftness a part of
the

~~133~~ ~~bn~~.

the fluid with it to bring y^e^ wedg-like action
round, w^ch^ is but so much more body added, that
~~is If~~ Instead of one, a great Number of body's are
driven, whilst In supposed vacuity, there is Nothing
but y^e^ body's under Consideration Concerned. So
that taking all y^e^ Substance together, there is a sta=
ted Quantity to be moved, as In vacuo, but Not y^e^
same. Then againe, the alteration the plenitude
makes cannot be much, as it may be ordered,
I Grant fethers or leaf Gold, or such light stuff,
will be Impeded in y^e^ air, but substance gets y^e^
better of that, ffor towers falling, Great Stones Rolling
~~they say~~ meet with litle Impedim'^t^ from y^e^ air, as
May be deomonstrated, from y^e^ Quantity, w^ch^ gives y^e^
force, & so litle Superficies, w^ch^ gives the Impedim'^t^.
Then they say the force of Gravity makes Great al=
teration; I ans^r^ that is taken off by suspension.
As if 2. Milstones were suspended in long cords
to high places, the motion of a minute or two of
a degree neer y^e^ perpendicular (/w^ch^\ may be a ~~Consi=~~ /very dis=\
~~derable~~ /=cernable\ space.) raiseth y^e^ weight but Inconsidera=
bly, & is scarce any Impedim'^t^ to such short Movem^ts^,
w^ch^ y^e^ proportion of a line of sines will readily shew.
In fine I account all discours of Motion In vacuo to
be a Chimera, a mere figment, and that whatsoever
Regulation's are found in y^e^ effect's of body's clashing
In their motion's, are Neerly Exact; and from the
Inconsiderable opposition of y^e^ Medium to heavy
body's disposed rightly for experiment wee May
account them, as so.

bo.

I proceed to Shew that Motion being Created, Must
have continuance, and be Regulatd by the Quantity
or substance of y^e^ body's concerned.

It was sayd, that If the direction /line\ of mutuall appro=
ach between any two body's, whither either or
both were sayd to move, transected their substan=
ces, they must Necessarily meet, and at the Instant
of the occurs some alteration of that Mode Must
happen /to Reconcile the opposition of substance to substance\. I add that the
alteration, whatever it is
must be in both, and Not in Either single, ffor
whatever is sayd to argue it to fall in one onely
is as true to argue it in y^e^ other, therefore it Must
be in both.

Then take the case of Equality, A=B. Strikes
it directly, If they adhere without farther, & Rest
in y^e^ touch, then onely. A. hath its Mode changed
And B. Continues as it was; w^ch^ Cannot be, for B.
must share in y^e^ Chang as well as. A. Then again
The chang on Either side must be Equall to the
Caus y^t^ made it, that is y^e^ Substance, in a certein
Swiftness. therefore B. must be moved with y^e^ Same
Swiftness as A. had. And A, that had that swiftness
must Rest In y^e^ point of contact. And No other
success will answer the Necessity, but that Gives the
Rule so, as an Equall striking its equall directly
Gives it y^e^ same swiftness as it had & Rest's In y^e^
Contact. And from thence it is Easy to Calculate y^e^
success, when both are supposed to move, either
approaching, or following, but I stay Not to Refine.

~~104~~ ~~ap~~.[168]

The Next case is of Inequality. vis^{t} . A. ⊏. B.[169]
Strikes it with any certein Swiftness. B. must Move
with the Same, ffor it is Impossible to have More,
becaus If it had had but So Much, there had bin No
approach at all. ~~and Nothing can be a caus of~~ /and y^{e} opposition never happened; But\
~~more then it~~ / then. A. Instead\ of Resting in y^{e} place of Contact, shall
follow with a Swiftness so proportioned to y^{e} whole
as the Excess of Quantity is to y^{e} whole. vis^{t} . as y^{e}
Quantity of A. is to y^{e} excess, so is y^{e} velocity after
to y^{e} velocity afore y^{e} Impuls. W^{ch} is all argued upon
y^{e} former reason; If an Equall Gave Equall Swift=
ness, a Greater cannot give less, and there is No
need to give more, becaus so Much takes away y^{e}
opposition. that for y^{e} chang on y^{e} side of B. but
then As to A. If an Equall took away all the
swiftness, B. that is less, cannot doe so Much, and
by how much less? ans^{r}, as y^{e} different Quantitys are
ffor Quantity is that /w^{ch}\ opposeth, and Makes the Chang
of y^{e} Mode necessary, any variation of y^{e} Quantity
must be Seen in a correspondent variation of
the effect. ffor. suppose A. = C+D. I~~i~~t will Not be
denyed but C. &. D. have upon all oppositions
some stated Effect; add y^{e} substances, & y^{e} Effects are
added. And so the Quantity of any body as also
the Corresponding Effect's, are as totum's Compound
of all their parts, and what is taken from y^{e} one,
will be Mis't in y^{e} other.

The 3. Case is of A. ⊐ B. and strikes it directly.
I say, B. Shall not move with y^{e} Same velocity
for

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[168] RN's 'own' numbering is never consistent.

[169] The 'strict' inequality signs, '⊏' and '⊐' (nowadays '<' and '>'), meaning less than or more than, were introduced by Thomas Harriot (1560-1621), an early innovator with algebra, in 1626. The 'unstrict' inequality signs (meaning equal to, *or* less/more than, with a horizontal line *above* the chevron) were introduced by John Wallis in 1670; the mathematical standard sign (still in use) adopted in the eighteenth century used an inverted form of this - with the line *below* the chevron.

aq.

for. A. being lesser, cannot have y^e Effect of an Equal[l?]
how much then must it Want? I ans^r. as the difference
of Quantity; for as A.B.:: the swiftness of B. after
to y^e Swiftness of A. before the opposition, on y^e other
side. A. was stop't by an Equall, that went away
with Equall force, there must be somewhat Els hap[=?]
pen, when it is stopped by a ~~less~~ greater w^{ch} goes
away with less swiftness. how shall that be? I ans^r
by Not onely a stop of A. but also Returning it in
a Contrary direction. by what measure? I ans^r the
difference of substance. ffor as the Excess of B. /beyond A.\ to B
So y^e velocity of A. Reflected In a Contrary direction
to the velocity of it before y^e opposition.

from these three Capitall cases, thus determined
flow divers admirable Corrolarys.

1. ~~That~~ Body's that Come together directly, par[t?]
again with y^e Same Swiftness as they Mett, saving
onely, where y^e future direction happen's to fall in
the same line, & y^e same way. w^{ch} is the second
case.

2. That If y^e least body in y^e World Strikes the Greates[t?]
It hath as true Effct as any other proportion, and the
Greatest is moved, & y^e less Reflected in just Measure
as In other proportion's. this May look strang, but is
Not More So then true, and it is a defect in our ap=
prehension, to thinck any thing lost becaus it is litl
no proportion off effect, holds In all proportion's to In=
finite.

3. when the difference of Magnitude is Inconceivable

br ~~135~~ ~~bh~~

as between y^e^ Earth's Globe and a Marble bullet,
The latter seem's to give no Motion to y^e^ former (be=
caus it is vastly beyond perception) but to Reflect with
all the ~~force~~ Swiftness of the access. Here is the Ground
of Reflection of one body from another upon Impulses.
ffor a greater Never Reflects. Some Solve it by a
Springyness in body; w^ch^ Supposed hath like effect,
but body perfectly obdurate do y^e^ like from y^e^ Ne=
cessity afore described. And a french Author is So
modest, to Call that Spring Infinitely hard, that
is No Spring at all.[170]

4. The Greatest of opposition's is Equall to Equall,
ffor If either side want, the opposition is less; In
Regard one side p^r^vailes, and proportionably with that

5. Body's have force according to Quantity' and
swiftness Combined. as to Quantity I have spoke, as
to Swiftness, the reason is y^e^ Same, more will have in
Effect more. And the swiftness is combined with y^e^
Quantity. that Increasing y^e^ Quantity, every addi=
tion brings also the swiftness with it. And double
Swiftness, in double Quantity, is Quadruple force.
The Notion of force is from y^e^ measure of chang as
Is made on Either side, w^ch^ is y^e^ Effect, for that in
force is more or less, w^ch^ produceth more or less in
y^e^ Effect.

6. At the Instant /of contact\ the force is scarce truely Sayd to
be in Either, but then, ~~y^t^ is at y^e^ Contact~~, It is in
both, & tends onely to a reseparation. ffor The
opposition

[v?]is Inertia^e^.[171]

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[170] RN might be being intentionally vague here, having forgotten which author. I have not been able (yet) to identify the discussion to which he refers.

[171] This in tiny handwriting, in the bottom LH corner.

~~bs~~. bs

opposition or necessity of separation ariseth on both
parts Indifferently, onely where is more substance,
there y^e^ opposition is stronger, as it would be In Every
possible manner of coming together, whe~~o~~ither one
other, or both Moved. And all other thing's Removed,
There is Nothing ~~Con~~/Af\firmed true but that they Come
together and separate. Therefore M^r^. Ns. vis Inertia^e^
is but an Expression of a vulgar thought, and hath
No true Science under it, but rather /Error\; ffor the vis is
In both according to Quantity, & in neither otherwise.

6. Hence In all percusion what soever, the action
is mutuall; and the Reaction to be accounted as the
action. W^ch^ as M^r^. N. Shew's, will be of Infin~~a~~ite use in
Mechanick solutions.

7. The separation of Body's upon percussion, is
as it were a continuance of y^e^ Same process with=
out stop or stay in y^e^ Contact /& y^e^ whole event is determined in y^e^ very moment of
touch\. ffor according to
Cartesius, If there be but a moment's Continuance
or Rest at the contact, No reason can be given
why those should part, then /there is\ that body's should
move themselves. Therein Springyness differs from
the Result of hard body's, foe some time passeth in
bending & Result of y^e^ Spring, but None is y^e^ other Case

8. Hence wee have y^e^ Resolution of Mechanick pow=
ers, ffor If a contrivance be made so as to Master
substance, by advantage of time, y^e^ work is done, and
this is y^e^ reason, of y^e^ proposition datum pendus Cum
data potentia.[172] but this is an head so copious & Im=
portant It deserves a place by it self.

[172] i.e., 'the greatest weight with the least power', RN is quoting Archimedes.

bt ~~136~~ ~~bh.~~

Hitherto wee have Not Supposed other, but /that\ body's
approach~~ing~~ In a strait direction, and Meet~~ing~~ di=
ametrically, so as the whole force of each is opposed
to the other; Next wee must Shew that /motive\ Direction
may possibly /be\ Curve, and /y^{t}\ body's may meet &
touch so obliq. that the substances doe Not Wholly
oppose Each other.

1. As to /y^{e} Means of effecting\Strait or Curve Direction /I observe\ the former is
necessary /&\ allwais /succeeds\ In a body free /or from y^{e} Instant of freedom\
however y^{e} /antecedent\ Move=
ment is made /or works\. ffor w^{ch} there is these ~~two~~ Reasons.
1. If the parts be not Equally or uniformely Swift
~~there is the Same Reason for~~ y^{e} slower ~~to~~ /must\ stay y^{e}
Swifter and y^{e} Contrary, ~~as for~~ /for y^{e} same reason as that\ one body ~~to~~ /shall\ Make
another /move or stay\. ffor part's Compounded act on one &
others substance as well as meeting from distance.
And all that is sayd of Impuls or meeting, is true /ffor divers body's doe but touch,
and so doe y^{e} parts of one & y^{e} Same body\
/also\ of parting, if any ligature /or connection\ stops y^{e} Cours, & y^{t} /may be
supposed to\ be
Shortned /even\ to ~~an~~ Imediate contact. for a thrust & a /draught\ or
clogg, have No naturall difference. ~~but~~ /They\ If a body
moves in any Curve, Some parts /must\ move~~s~~ swifter
then others, Ergo. &c.. This is the just caus of all
Rectiliniar Motion, but It may be added, that
motion is in a medium, that is in pleno, w^{ch} Im=
pedes more swift the slow transits /& so Reduceth y^{e} former\. but I Rely Not
on this becaus I take the Rectiliniar direction to
be determined In y^{e} Moment of y^{e} Contact. /This will be granted in case of motion once
directed in a strait line. but\ Then
Say some, suppose a body deteined In a /curve as for Instance a\ Circular
movement; and set free, why Should Not y^{e} Same Cours
continue?

~~bl~~. bu

continue? I ans^{r}, first as before, and Next, that
a curve. is but an Infinite-sided Rectilinear figure,
as a circle ~~for Instance~~, is ~~an~~ /one\ Infinite Angled, & Rec=
tilinear. for y^{e} ang. of Contact, as Mathematitians
agree, is nothing. and y^{e} tangent in y^{e} Contact, tho
but a point is part of y^{e} Circle. then a body Mov=
ing in one part of a strait line, vis^{t}, y^{e} tangent
Must Continue so to doe. what should divert it? /In fine
there needs no farther demonstration then this all motion and y^{e} direction of it is
determined in a moment, and there is no curvitude in a point, therefore it must be de=
termined strait. \

Hence it follows, that a body deteined in a
circular movem'^{t} , and set free, moves in a tan=
gent, to y^{e} first point of y^{e} freedome;

Hence also body's moving circularly, must tend
to Recede from the center, for the direction being
by y^{e} tangent, It must be /a\ force continually /applied that\ ~~added~~
~~to Reduce~~ /can Retein\ it ~~to~~ /in\ Compass.

But of these Matters more Expressly hereafter.

2. As to Curve directions, I account them properly
belonging onely to the parts of ~~compound~~ /single or continued\ bodys,
/And such as are anyways connected as In [enginns?],
it is y^{e} same thing\ ffor Every body, whither y^{e} whole be accounted to
Move strait, or not, may turne round, W^{ch} is chang
of position, and Respects y^{e} part's onely, and What
Aspect they bear to y^{e} Circumjacent bodys. ffor if
a body turnes, the other's are supposed to be at
Rest; and If those turne too, y^{e} Same way and so
as they keep y^{e} Same aspects; the turning vanisheth
& is Nothing. If y^{e} body be supposed at Rest, the
other's turne, but /be it\ one /way\ or other, while y^{e} aspects
chang /In some manner\ it is the same thing. therefore wee will

~~137~~ ~~bw~~ ~~bm~~[173]

suppose, the circumjacent body's, that is our owne /for one\
(y^e^ Spectator,) to Rest; & so y^e^ turning of y^e^ other is
declared. Now that this turning may be, and /that\ Ma=
ny /nay Infinite\ Severall way's /at once, & all consistent\ is argued as before, /
vis^t^\ that any
chang In y^e^ modes of body whatever ~~y^t^ are~~ /Not In=\Con=
sistent with the hardness & place, are possible. As y^e^
Body A. may turne upon y^e^ center or axis. BD.
<diagram> And at y^e^ same time from some other Caus
turne also upon y^e^ axis, A.E. & so /on y^e^ axis F.G. &\ Infinite other
way's. and ~~so~~ the path of any one part, as
B. (for Instance,) be a /sort\ Curve ~~&~~ /or\ Recurved line
formed ~~by~~ /upon\ all those /different\ motion's, ~~with~~ /tho with\ Infinite
variety, and such thing's are y^e^ work of Mathe=
matition's to Investigate & bring to rule, ~~so as~~ /&\ to
be understood /or Calculated\ If they can.

One grand proposition w^ch^ I take to be true In all
cases of free turning, is that y^e^ Motion shall be
upon an axis w^ch^ cutts the center of y^e^ body, and
this /holds\ universally. In all body's, & shapes Regular
and Irregular. This will be of Great Consequence
in y^e^ cours of these observations; And for proof of it,
I argue thus. circles are as their diameters, there=
fore Each part moved round is swifter then other, accor=
ding to /the\ distance /of it\ from y^e^ Center, and that Indevisible
point /or axis\ onely, Is /Imagined to be\ Infinitely slow, y^t^ is Stands Still. Then
In y^e^ Same body, the part's acting upon one & other
If the swiftness be unequall, there is accelerating
& Retarding, till some Equality take's place;
And that cannot /possibly\ be by Equa~~ll~~/tion of y^e^ same\ swiftness, therefore
It

[173] RN has here crossed out 'bm' himself.

b~~n~~x

It ~~Must~~ /shall\ be Reduced to an uniforme Swiftness. that
is the part's on one side of Every axis=plane shall
have y^e^ Same force as y^e^ parts on y^e^ opposite side.
W^ch^ cannot be, but by a Movement upon the
true center of the body. ffor there the force is a=
justed as was observed, by Quantity and distance
In counter proportion to Each other.

I beleev a moderate attention to comon &
accidentall movements will shew this to be true,
ffor Nothing but a perfectly adjusted round
moves smooth, ffor that hath a Regular axis
Next the Quadrates, & other's uniformly Re=
gular. But Irregular body's, Move perversly,
as is seen when they are tos't in y^e^ air, with such
a movement Impres't. as for Instance, the body
<diagram> A. will turne upon a center at. C. So that
y^e^ part's at D. Shall move very Swift, &
those at A. slow, but then substance at A.
makes y^e^ Equation. And Whither the whole
be progressive or Not, this turning is on y^e^
same axis, onely If you are to describe y^e^
path's of any part's, with Relation to y^e^
circumjacent Resting bodys, It is More complex.
So that as y^e^ observation ledd me to ~~to~~ this opi=
nion of turning Motion's, so y^e^ consideration of y^e^
Reason of it upon y^e^ former principles, confirmes
my opinion of y^e^ turning with Conformable Exact[=?]
ness, but If these Irregular Extension's of matter in
the shape & sort's of substance, be considerable the
Impediment

~~138~~ ~~boy~~.

Impediment from the medium hath Great Influ=
ence to disturb this effect. ffor suppose the promi=
nences spread out farr & thin as a tail, or as an
Arrow, having a solid Head & thin shaft, & perhaps
feathered at the End. there the Impediment from
y^e Medium is such, that toss y^e body as you will y^e
motion shall be according to y^e extended length, &
y^e lighter part follow y^e weightyer. therefore wee
here abstract y^e Impediment of y^e Medium, or, W^{ch} is
y^e Same thing, suppose y^e Materiall so Gross, & y^e pro=
tuberances such, as surmount y^e Impediment, & Make
It Inconsiderable.

And knowing how Much is ordinarily ascribed to
y^e Medium, to trouble all hypotheses about Motion
and Especiall of that founded on plenitude. I take
occasion here to Examine that matter, ffor many
Strang Effects In Nature may be Consequentially Re=
solved. The main consideration is, that Motion hath
force from substance, & is accordingly More or less, but
Impediment is wholly upon Superficies, so that
The proportion of the superficies to y^e Substance of
any body, gives the power to y^e force, or to y^e Im=
pediment, as ~~it~~ /Either\ p^rvailes. ffor If y^e Substance be great
and y^e Superficies Not considerable, y^e force meets
Inconsiderable Resistance from y^e Medium, & E Contra.
This May happen Either from figure or from Mag=
nitude. ffor all oblong body's, Endways have Grea=
ter force /w^{ch} is y^e caus battering Ramms have such force\ so If they be formed wedg-
fashion.

y^e Ex=

~~bp~~. bz.

ye Experience of wch is obvious & comon. Then as to
Magnitude It is No less demonstrable, that Great
body's have less Impedim't from ye Medium then Small
ones have, becaus ye superficies is litle In proportion
to ye substance. as. a Dice. is. cube. 1. superfi=
cies, 6. (vist. as 1. to 6.) 4. dice is cube 4. and
Superficies, 24. (vist. as. 8. to 24. = 1. to 3.
So the proportion of superficies to ye Substance
of one cube. being 1/6. take ye Cube of double the
root, and it is /but\. 1/3. no wonder that Great body's
have More force to move, then smaller. Hence wee
have divers admirable solutions. as. 1. that the
reason small dropps wch Compose mist's & clouds
hang in ye air, and when greater fall in Rain.
so. 2. Iron pulverised Impalpably, hang Invisi=
bly In water. &. 3. the Celestiall body's as ye
planet's, or Grand Vortexes, have not sub obs=
truction's to wast their Motion as lesser, of our
Neerer acquaintance have, and so May persevere
More. wch shews ye weakness of Mr. Ns. Argument
that becaus all Movemts wast, therefore the car
tesian System /of ye heavens\ cannot be true; admitt that waste
one cannot thinck it Could be sensible, In 100000
years, whereof wee doe not allow, 6000, yet spent
and by what should wee know or perceiv its wasting
It may be ye Revolution's were Quicker afore the
flood, wch might a litle answer ye longevity
of ye

~~139~~ ~~ca~~. bq.[174]

of y^e patriarks; If that bauble of a childs topp
be Considered, how many 100, turne's it makes be=
fore it seems to abate; and calculate the propor=
tion between that and the saturnian orb. w^ch
May not be 1/10. of y^e diameter of y^e Sun's vortex; And
the value of y^e Impediment subdubling, as the roots
or diameters duple, ~~And~~ there will be found Small
reason to argue any sensible wast In y^e movements
of y^e planetts, In our Inconsiderable age of y^e World, and
I may Justifie y^e Epethite, Considering y^e Magnitude, If I
allow'd y^e chinese or any other fabulous acc^o that
Ever was made of time. but so men will argue when
a caus is Espoused, as with him that of opposing
cartesius In Every thing, is plaine Enough done.

But now to Returne to the cases of Motion, w^ch have
had a generall view, that is, the consequences of
collision's in direct cases, determined by Quantity
and swiftness; And then the nature of directions
Rectilinear & curve, whereof y^e former belongs to
free body, & y^e other to the part's of continued or
single body's; This matter of directions and y^e Con=
sequences of y^e Same upon Impulses, is a subject
to be more nicely treated; And I must once more
Respect that In the direction of Motion, there is
so much reality, that the meeting & clashing of
body's, depends wholly upon it; & without Such
meeting, Motion hath no reality, but In <u>Relation.</u>
<flourish underline>

[174] 'bq' washed out.

cb.

It will be needfull to pass some Items, w^ch will Not
be Controverted, and /being Explanatory\ conduce to establish others, as.

1. The distances of all the body's In y^e world, & of
the severall part's of them from Each other, are Cer=
tein & [computable?], as Quantity it self is.

2. This distance is taken upon the shortest line,
W^ch Joynes y^e Severall body's or parts, & that I Shall
call y^e line of distance. And If here I /Sometimes\ take ~~a~~ body's
~~as If it were but as~~ /to be as\ points, I shall not fall into Error
becaus I Referr all y^e Quantity to y^e center, and at
p^rsent suppose that point to be y^e place of y^e body, &
this will be made more plaine hereafter. but In y^e
mean time when I Speak generally of distance &
direction, It is Intended from centre to center.

[marg][175] 3. This distance, May Continue y^e Same, or chang
and that In all degrees of More, or less; w^ch are Called
Swiftness; and ~~is~~ /are\ subject to multiplication & devision
ad Infinitum, whence time is accounted & compared
and may be taken ~~In~~ /according\ any given Measure.

4. Body's taken Intirely May continue the same
distance, and y^e part's vary, w^ch is Called turning
and allwais changes the position or aspects of
body's; or body's may chang distances both of
y^e whole according to the Centers, and by part's
also at y^e Same time, & so by Infinite Manners,
as hath bin Noted, without Impedim^t, or Inconsistency.

[175] '*q^u*' in margin.

~~140~~ ~~cc~~.

5. But to bring our specualtion's from Infinity
Into Examinable compass; wee allwais Suppose
a Systeme of body, w^{ch} is a certein Number as
occasion May Require, & then Imagin all y^{e}
Rest of y^{e} world annihilated; for If wee transferr
our Regards abroad, wee loos all o^{r} footing, &
that w^{ch} was motion May be called Rest, & E contra
In all degrees.

6. When the ~~line of~~ distance between bodys
changeth, that is they approach or depart, It is
Either upon y^{e} very line of distance, or upon
Some other line. And so the line of direction
and y^{e} line of distance, may be severall. If
the movem'^{t} be approaching I shall call it, y^{e}
access, and If deviding, Departure; and the lines
of access, is the direction of the body's approaching
& y^{e} like of departure.

7. If the line of direction be coincident with the
line of distance it is Necessary upon access y^{e} body's
touch /In Some point of that line\, otherwise they may Come to a neerest dis=
tance & depart without touching. As A. & B. ap=
<diagram> proach upon y^{e} direction & distance
A.B. It is necessary they come together
upon, D.C.E. or some other point.

8. If the Contact happen upon Either Extremity
then all y^{e} movem^{t} is ascribed to the opposite body
and Rest to that. as If the Contact be on B. then
It is A. onely y^{t} moves, If upon A. then onely B. &
A. Rests.

129v

~~ef~~. cd.

9. If the meeting & contact be upon y^e^ midle point
<diagram> C. then Each body moves with Equall
velocity, If upon 1/4. as. E. then A. with
3/4. & B. with 1/4. of y^e^ velocity & so in all other pro=
portions. Thus the Motion ascribable to the bodys
~~under~~ /in\ a state of approach, is determined by the
Intermediate point of y^e^ line of distance, or direc=
tion of y^e^ access, In w^ch^ the meeting, or Neerest distance
happens. To Give an Example. let A.B. be the
<diagram> direction of both body's, that is
the line of Distance & of access
coincident. the meeting must
be In some point of that, as before,
but If the direction of B. be to C. and of A. to E.
they may Never touch. but Come to some Neerest
distance as F.G. & then depart againe.

10. The swiftness of access is Not y^e^ Same with that of
the Movem'^t^, unless, the lines of distance & access
are Coincident. as the line of distance between
<diagram> C. &. B. is C.B. Suppose. C. to Move
& B. to Rest. and y^e^ direction of C.
to be. C.D. I say. B.E. the shortest
access, is less then that of y^e^ distance. C.D.

11. If the direction be a line y^t^ makes an
acute ang. with y^e^ distance y^e^ body's approach, Els they
depart. as If ~~G.B~~ /C.F\. □[176] B.C. be y^e^ direction, the distance
Increaseth (as y^e^ hypotenuse of a Rectang. triang.) by
y^e^ Movement; and y^e^ least acute is some aproach, &
obtuce, perpetuall departure.

---

[176] I understand RN to be using the figure '□' to represent 'the angle between' … but I am not satisfied with this understanding.

ce ~~141~~ ~~eg~~.

11. If body's ~~have~~ /move in\ direction parallell, they Can never
meet to touch, but may depart ad Infinitum and
Come No Neerer then a line cutting y^e^ paralells at
Right angles.

12. If the directions Intersect Each other, and the ve=
locity's are proportioned to y^e^ distances from the point
of Intersection, they Shall meet & touch in that
point; whatever y^e^ distance from Each other be, as
<diagram> C. Moving towards D. &. B. towards
A. If the velocitys be as y^e^ lines
CE. &. B.E. vis^t^. velocity C.B. ::/lines\ C.E:
B.E. the~~y~~/bodys\ touch in E. And In like manner, If the
proportion holds Not, so as y^e^ body's doe Not touch
the points of neerest distance, If occasion be are
Calculable.

13. To calculate the velocity of y^e^ access, that is by
what degrees compared with y^e^ velocity of y^e^ Motion
the body comes to y^e^ neerest[177] distance. let C. Move in
<diagram> y^e^ /tangent\ direction C.A. & B. Rests. the Shortest
distance will be Rad^s^. A.B. and the longest
Distance. y^e^ Secant C.B. the difference. C.D.
amd that Exposeth the velocity of y^e^ access
as C.C. y^e^ tangent, Exposeth y^e^ velocity of y^e^ Motion.
So that. tang. C.A. secant C.B. - Rad. D.B. :: the
velocity of y^e^ Motion to y^e^ velocity of y^e^ access. If B. be
Supposed to Conspire In the approach by Moving towards
A. or B. or any other part, y^e^ Calcule grows more
perplex, but may be found, and all that is true in
cases

[177] The word 'neerest' is written over another (possible the same) word.

130v

cf.

cases of access, will hold in cases of departure
by Inverting y^e termes.

I proceed Next to Consider what alteration of the
direction of movent body's upon mutuall Collision
of them. for Such must happen, becaus the same Can=
not continue without penetration; and If y^e body's
y^t Meet must part, It must be for y^e Most part in
different directions, w^ch is y^e buissness to Shew. And If I
here use diagrams In plano, I must beg assistance
of y^e Imagination to translate them In Solido.[178]

Every contact or Mutuall Impuls of body's, is Either
by a point line or superficies. If by a point, wee Call
it the point of Contact. If by a /strait\ line then y^e Midle
point of it is the point of Contact; ffor What ever is
Argued to alter y^e Case one way is answered by as
Much to set all right againe y^e other way. If y^e
contact be a curve, It amount's to A superficies
as If (y^e Curve Not closing) the 2. Extream points
were Joyned by a strait. If by a Superficies y^e Center
(according to y^e Notion of a center of Gravity) of that
superficies, Is y^e point of contact; w^ch Stated, I say

The point of contacted is to be accounted (as
Every Imaginary point in y^e World is) y^e Center of
an Infinite Space Extended spherically Every. and
ffor observation sake, account it the center of a
sphear, from /some point in\ whose circumference Every direction of
motion Comes, & Returnes /or goes\ to Some other. & this wee
Shall call the sphear of the direction

[178] i.e., 'imagine my 2D diagrams as 3D'.

~~142~~ ~~bc~~. ~~cg.~~

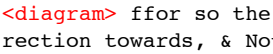
Every Surface of a body touched by another, is
Either strait or Curve; If strait, then No body Can
touch any point upon that flatt, but what Comes
from Some point of the Sphere, or rather hemisphere
of ye direction, whose diameter plane, is Coincident
with that flatt. If Curve, there is Ever a tangent
plane to ye point of Contact And No body Can
touch another upon any point, of a Curve super=
ficies, unless it come directed from a point In the
hemisphere, whose diameter plane, & that tangent
plane, are Coincident. So A plane Coincident /with\ [~~or~~]and
tangent to ye point of Contact, wch is ye Center, de=
vides the Sphear of direction, Into 2. hemisphears.
And that Wch Respects the Movent I call the hemis=
phear of access, & ye other that Respect's the tenden=
cy of ye Movement, the hemisphear of departure.

<diagram> As. A.B.D.E. is the sphear of ye direction
A.B. the plan of ye Stroke, or tangent to ye
point of Contact. C. A.D.B. is the hemis=
phear of ye access, and A.D.E. that of the
Departure.

prop. It is Impossible that a body. C. Struck by a
body directed from ye Hemisphear of ye ~~acess~~
access; Should Receiv any direction Into ye
Same hemisphear, but it must be directed
some where Into ye Hemisphear of ye departure.

131v

ch.

 ffor so the body struck will move In a di=
rection towards, & Not from the body that
strikes it. for let the direction of c. struck
be Not to E. or any point in ye hemis=
phear but to F. In ye hemisphear. AD.F.
let. ang. H.C.A. = F.C.B. Joyne. H.f. then
If ye point C. must move towards f. the whole plan, or
Tangent A.B. must fall /in\ & be Coincident with. H.F. wch
is directly agt the force from. D. and whither ye Superficies
A.B. or be it a tangent to a Curve be more or less Spread
It is the same case, for ye Sphear A.D.F.B. may be demi=
nished towards ye Center, ad Infinitum.

The Next proposition will also prove this.

1. prop..[179] The body at C. Receivs ye Same direction
<red BM stamp> from ye stroke, from what point soever of ye
Hemisphear of access ye force comes. As If the body
that Strikes Comes from H. and the direction of
ye departure be C.E. If ye force Comes from. f.
it will be ye same.

ffor supposing as wee doe, that ye point of Contact
C. Receivs ye stroke, and ye Separation In the same
Instant; It is all one from whence ye force Comes. ffor
[it?] is No other but Contact upon a point wch allows No
variation.

This proves ye foregoing prop. ffor say upon ye Stroke
c. shall Not Move to E. &c. but to. F. then (construct [or?]
before) from ~~A~~ from. f. must have ye Same effect, so the
departure /of C.\ is , directly opposite to ye access of B. wch is
Impossible.

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[179] The term 'prop.' (i.e., proposition) is used repeatedly over the following pages. It is often emphasised by being written in a slightly larger script, and often appears correspondingly more heavily inked, or bolder, as it might have done in one of the printed examples RN is imitating.

~~143~~ ~~ci~~.

 prop. The greatest force, is from y^e^ vertex
of the Hemisphear. D. the direction being
Rectangular to the tangent of y^e^ Contact.
but as the direction Inclines, as to f. the
force deminisheth as y^e^ Sine, ang. f.c.G.
vis^t^. f.G. to Rad^s^ . f.C.

Let the tangent or plane A.B. be Extended to y^e^ pe=
rimeter of the supposed Sphear of y^e^ direction /Then\. ~~ffrom~~ y^e^
point D. /to C. is\ ~~is~~ the shortest, & so y^e^ Spedyest access that Can
be to it. therefore it is Impossible /for y^e^ force\ to fall more Effectually
then from thence. but from. F. the shortest access to y^e^ plane
is /not the direction F.C. but\ y^e^ sine. f.G. and in every moment of y^e^ access the same
proportion holds between F.G. & F.C. Even Into y^e^ Contact
so that /y^e^ force from\ f. falls upon. C. by a slower access, then from
D. It cannot be Replyed that I assume arbitrarily the
Extent of y^e^ touch, w^ch^ is but at. C. a meer point. I ans^r^.
There is an Incoative Quantity /or Extent\ between y^e^ point C. & F.
and that is no sooner any thing then the proportion of
access takes place; or In other words, y^e^ last moment of
the access is Slower from F. then from. D. And If from
f. a body is to pass F.G. In y^e^ Same time, as /o^r^\ force from
f. arrives at C. it Must be slower, as fG. to F.C. y^e^ Sine
to y^e^ Radius.

This Radius D.C. I call the axis of the force or of y^e^
access, and C.E. the axis of y^e^ departure, for like reason
as will appear.

ck.

prop ... Every body struck, at the Instant of the
percussion is determined to Move in some
certein direction. and the like Impuls shall
allwais produce the like direction.

This is so sure, It might be wrote as an axiom, ffor
Quantity of Substance is so exquisitely terminated
& ever y^e same, can have no operation, but what is
as certein & Necessary as its owne Essence.

prop. If a body be ~~touched~~ /Impelled\, Not Imediately, but
by mean's of the Interposition of another,
the direction of it upon such Impuls, shall
be y^e Same as If the stroke were Immediate
upon the point touched.

<diagram> As A by striking B Impells c. con
tiguous to it at D. I say the di=
rection given to. C. shall be the
Same as If it had bin struck Imediately upon D.

This is No less clear, for what is done by touch u=
pon y^e same point, can have No diversity, for y^e point
is Indivisible, & doth Not admitt it.

prop. If one body touch 2. others or any Number
and is smitten, there is the like argued of
Every one of them.

<diagram> As A Impelling B. B. Impells C. &
D. as If they had bin severally struck
upon y^e points of Contact Immediately

~~144~~ ~~el~~.

The like holds of any Number of body's Contiguous
one to another, thro all Contiguity's, ad Infinitum.

prop. If body's are Contiguous as above, and
fixt together, so as Not to be Separated. the
Influence of yᵉ stroke affecting them is by the
same rule, as would take place, In case they
were loos and Could Move.

<diagram> As. B. & C. are united In yᵉ point D.
and B is Impelled at E. I say the
Influence of yᵉ Stroke upon. C. is the
same, as It would be If it were loos
& Could Move.

This is proved by yᵉ former, but for yᵉ Word Influence
It mean's No other, but the Effect of yᵉ Stroke upon. G.

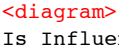
prop. If in yᵉ former Instance, the Direction of
C. and that of D. Influenced by yᵉ Stroke
are Coincident, they shall Move in yᵉ Same
posture. but If D. have a different direction
from. B. the the Influence of yᵉ Impuls shall
Caus the body's to turne as well as to Move
progressively.

The first is plain, If they have both a Coincident di=
rection there is Nothing to determine or Incline a
turning Either way. But If. E. tends to [Ƀ?]F. and
[Đ?]C to. G. both those tendency's Cannot have their
Effect, but at yᵉ Contact, In a Mixt & Mutuall
cours

cm.

cours, as must happen by Each hindring y^e other, and
drawing it aside from y^e proper direction.

It is to be Remembred, that a turning once began, fall's
Into a movement upon the center of y^e body, however
y^e occasion was: And this Instance of 2, extends to all Numbers.

 prop. A continued body upon Every Impuls
Is Influenced [so?], as Every part shall have a
tendency by strait lines from the point of
contact.

This is solved by Imagining the body Composed of Infinite
small Globules, or parts, and then y^e Result is aeccor=
ding to the proposition. for the part. E. cannot be pro=
truded but by y^e [Intermediates?], one way or other; so of
the Rest. Now if it be say'd the part's compounding
Most body's are Irregular, & there is No certeinty but
y^e part c. &. may be thrown, or Influenced awry from
y^e direction B.c. I ans^r. 1. that such body's If made
up of Irregular parts, are uniformly mixt, then
I argue y^e Same, that what falls, /one way\ to cast y^e direction
aside ~~one way~~, hath as much to Reduce it by another,
and so y^e mean of all Extravagant's Governes, & pro=
duceth the Same consequent direction as If y^e
part's were all Regular.

This proposition is complex, & uncapable of demon=
stration from particulars, vis^t, y^e shapes & contact's
of the several parts, such being Not examinable;
Therefore it Must be allowed, that accident May
produce a variation in some Instances. As perhaps
the

~~145~~ ~~en~~.

the part c, may be of such a Shape, that If loos
would goe off by c.g. & Not by B.c. Continued, but
other's would deviate as much another way, w^ch still
Recurrs to y^e Mean. But If a body or part[,?] be Single
and without pore, y^e proposition is Exactly true, for No
part can be driven there, but by that w^ch lys directly
between y^e Contact and it, and so Must goe off
If set loos, In a line from y^e Contact Continued, this
I say for caution, Not Meaning to advance Incertein=
tys for Rules.

prop. The like is true of the body Striking, ffor
that Resisted at B. all the part's are Resis=
ted by that strait Comunication, between
all the part's and the Contact. And as to
all Influence of Impulses, they operate on
both body's exactly In y^e Same manner.

prop. A body that Moves from the Contact, by
y^e axis of y^e departure, hath Most swiftness
of departure, then to any other point. /And &c.\

<diagram> This is y^e Revers of y^e prop.. concerning
the Swiftness of access, w^ch being Inclined
to y^e tangent or plane, deminished
In proportion of sines. so here by like
Reasoning. the swiftest departure of y^e
body C. from that point. is. C.F. but If it be Not to
F. but to D. then at D. the distance departed is
D.G. the sine, and y^e Motion C.D. y^e Radius

co.

prop. when a body is made up of parts or other
<diagram> bodys conglomerate. and is struck, whereby
ye parts are all Influenced to Move in di=
rection continued from ye Contact, thro Each
part; the Effectuall direction, Shall be /in\ a
medium of all those.

As here C.E. is struck in. C. and ye Influence
is exposed by Ray's directed strait from the
contact thro Each point. It is Manifest that
the Influences towards D. Incline the body to Move
that way, and those towards F. Incline it that Way
wch Influences of opposite power, must produce an
Effect Indifferent, or Equated between both. So as the
powers on Either side are ballanced.

prop. The direction of Every body In ye world, that
Receivs a stroke from another, is by a line
wch Intersect's the point of Contact and ye
true center of the body.

As In ye former diagram, C.E /passing thro ye Contact c. & ye Center D.\ shall be the
direction
ffor by the rule of centers, the part's Every way about
that axis. C.E. have Equall force, either by Mean's
of Quantity or distance from ye center or axis, both wch
are ye factors of ye force. then the part's towards. D.
on one side of C.E. have Equall Influence & power
with ye parts towards. F. Ergo. &c.

But lett this be denyed, and Say the direction Shall be
C.H. then moves from ye Contact faster then ye parts. D.
ffor those In some sort approach it. wch will not be.

~~146~~ ~~ep~~.

This is a most Important proposition, and is that I
have Not Mett in any author of Mechanicks, vis^{t}, one
/comon\ -Rule for the direction upon Impulses of all body's
upon others. Their discourses have bin most of Globes,
w^{ch} are Regular, as may be seen by M. pardies who
hath bin y^{e} Greatest dabler In these Matters. and of Such
the Case is Notorious, as upon the center diameters of
cubes & y^{e} like, but this Goes to all universally.

I know there will be objected, that the Turning w^{ch}
is consequent of Some Impulses, breaks all our Mea=
sures & arguments; I ans^{r}, Not at all; ffor y^{e} turning is
not opposite too or Inconsistent with y^{e} progression. I ad=
mitt as to opposition or yeilding. the turning is very
considerable as will be shewed, but as to the progression
or departure from y^{e} Contact, with whatever swifftness
It happens to be. more or less, there is No reason to
urge for y^{e} altering of ~~it~~ y^{e} direction of it. the rather
becaus the turning carry's a perpetuall Equall
force on all sides y^{e} axis, so that If one part Should
draw y^{e} direction aside one way, the parts on y^{e}
other would set all right againe.

prop. If the direction of the departure, and the
axis, are not coincident, the body must
turne, and so much more as y^{e} angle of
difference is opened, and at y^{e} Quadrate
or Rectangle (or rather Neerest it) most
of all. y^{e} turning allwais Increasing as
that Angle opens.

135v

cq.

As y^e body. F. is struck at. C. of w^{ch} stroke, C.D. is y^e axis
of departure, and C.E. the direction of it. I say that
body Must turne. ffor admitt it as 2. devided at. a.b.
It is certein that If y^e part towrds G. had the direction
<diagram> by y^e axis. C.D. and Influenced to that, but
then Reunite y^e other part F. it must draw y^t
direction, or ~~rather Retard~~ /Incline\ the motion, tow-
ards. E. and the parts C.b. Must draw y^e part
F. so the Effect must be mixed of these 2 Influ
Ences.

But this then clears the Matter, all the Influ=
ences of y^e stroke, are stronger as they are neerer y^e
axis, as was shewed, in y^e proportion of sines. therefore
In case of Inequality, as here, ~~the greater~~ /some\ part draws
towrds F. & So Neere y^e plan or tangent of y^e Stroke
and are consequently weaker, as at F. w^{ch} parts. F. I
here suppose Equall to y^e parts C.b. but those draw tow[=?]
ards D. stronger then F. doth towards E.B. and Conse=
quently y^e body Must turne.

But If the direction C.E. were Coincident with C.D.
y^e axis. then from a parity of Influence Either way ther[e?]
would be No turning at all. on y^e other side, If y^e body
lay most towards B. then as a/n\ ~~line~~ /oblong body\ struck upon y^e Extre
mity, It would turne with y^e Most swiftness. and So as
y^e ang. D.C.E. opens, the turning Increaseth, In w^{ch} pr[o=?]
cess all y^e substance lying on one side is y^e extremity,
In y^e way of turning, and the axis & direction being
coincident, is the Extremity In y^e way of pure progres
Sion.

~~147~~ ~~cr~~.

prop. If the body F.C. be Supposed Movent
and Resisted at. C. after ye Impuls It shall
turne. vist. F. towards B. and C. towards D.

This doth but Invert ye Reason of ye other, ffor chan=
ging ye words, for force (ye former case) ~~to~~ /take\ Resistance
(ye present.) wch in truth are /termes\ Convertible and May be
taken on either side, and in reality are ye Same
thing, the argument is ye Same. for ye parts betwen
ye Contact and A. are less then between that &. B.
and both have fore according to Quantity to proceed,
towards some part of ye hemisphere. H. but C.B. being
more, prvaile, wch must turne the body, and ye pro=
cess & extream's are as In ye other case. In yt case ye
parts B. hang back, & here are forewarder, & thats
all ye difference, wch is Nothing If the Regards to sta=
tionary things be altered; and what was sayd to
stand still, be sayd to Move; then the body. F. was
Either ye, Reaster or Movent accordingly, wch Notion Can=
not be too often Remembered.

prop. A body ~~that~~ turnes, the fforce taken at ye
Extreme parts, is less then the ~~same~~ fforce
upon progression, with ye Same swiftness.

for In pure progression, all ye part's have the same
swiftness, but In turning, the swiftness deminisheth.
from ye Circumference towards ye Center; so yt the parts
have unequall swiftness accordingly, & if the greatest
Swiftness, be Equall to ye progression, ~~If~~ the force of
ye whole so turning is less then yt of ye whole in progression.

cs.

prop. As the turning Increaseth In swiftness, so
the swiftness of the progression demini<u>sheth.</u>
ffor the obliquity of y^{e} direction of y^{e} Stroke to the
axis, is that w^{ch} Increaseth the turning, and at the
same time, the same ~~Im~~ obliquity debilitates the
body, In y^{e} case of Movent, as to its force, at C. and
consequently opposition at the same point, C: In
y^{e} proportion of sines.

Hence the turning and the progression together ta=
ken, equall the force of the body Moving, In Such
Swiftness, as the stroke would have given had the
axes & direction bin Coincident.

Hence also, the force of y^{e} turning, is to y^{e} force of
[progiction?], of y^{e} same body, as y^{e} sine of the ang.
between y^{e} plan or tangent C.B. and y^{e} direction
C.E. vis^{t}. as sine. E.B. to Rad. C.E.

Mdum[180] when the axis, and direction are Coincident
I call it a direct Impuls, and when severall, obliq.
The first are /In Regular cases &\ those Impulses, w^{ch} In statick language
are sayd to be ballanced; and y^{e} others, Resemble
also a sort of ballance, called a Stilliard, but belong
to all Irregular and unequall Cases. however by
the means, of the tangent to y^{e} Impuls, and y^{e}
Sphear, by y^{e} foregoing application, brings all
Regular & Irregular to the Same rule.

And these case's of Obliq & direct Impulses, are
to be considered both In movent and the body
struck.

[180] i.e., 'memorandum'.

~~148~~ ~~ct~~.

Struck, Even in one & y^e^ same Impuls, W^ch^ gives a
plaine and clear Notion of many practicall Won=
ders In Mechanicks, such as they call Sailing ag^t^ the
wind and the like, w^ch^ however Wrapt up in ~~per~~
Complexity of matter, is Reducible, & Resolvable by
this Speculation, of Individualls, upon the Effect of
obliqe Impulses.

<diagram> As for Example let the force come from
D. upon. C: It was shewed y^e^ direction
of C. would be y^e^ same as If it Came
from F. or any part of y^e^ hemispere.
Then let y^e^ obliquity of y^e^ puls on the
part of C. caus the direction to be tow=
ards. E. Then the Success will be such
that the direction of y^e^ ~~Strated~~ stroke, will carry y^e^
body within 10. or. 15. degrees of y^e^ hemisfere, from
the very access of the force, that Caused the ~~mathr~~
motion, w^ch^ (In seaman's language,) is as neer as a
Ship can sail by. So also In Windmills, y^e^ wind fal=
ling obliq on y^e^ Sails, carry's them Round, & many
like Instances might be given; All w^ch^ are y^e^ Creatures
of proof & Experience, for it is Impossible, otherwise
to Compose such Engines as those are. And it is very
hard to Resolve them Into these principles, by fin=
ding out the sceme of y^e^ access departure, with
y^e^ obliquity's, so Invelopped are they in Inextricable
multitudes of parts. But Instead thereof, I will
lay downe this rule, as universally true In Mechanicks.
Nothing

137v

cu.

Nothing can be performed by aggregate heaps
of Matter, y^e^ cannot be Reduced to, and Resol=
ved by Instances simple and Intelligible in
the Method foregoing, or some other of like
Invention.[181]

I Must Confess that the Invention of this, by me, for
bringing Irregular Cases of Motion to Rule, was Not
y^e^ product of analitick, or any Reasoning, but Meer
observation of fact. And Not by any Nice or vexatious
Experimenting way's, but by comon and obvious
occurrances of mottion, that are of Quotidian view.
ffor one Cannot, Even In y^e^ Scholastick State, but ob=
serve, when the litle double-piramid of wood, they
call a catt, was struck with a battoon, upon the
very Extremity, It would twirle with wonderfull
swiftness, but as to flying away, cheat y^e^ Stroke,
And when Struck upon y^e^ Midle, It flew away Swift
and Made No turnes, & y^t^ is y^e^ [act?] of y^e^ Stroke. so
If struck upon an Intermediate part, It would
fly with Indifferent Swiftness as y^e^ Stroke was
placed neer y^e^ midle, and turne also more or less
as y^e^ strok approached neer y^e^ extremity or Midle
of y^e^ litle Machine. The resolution whereof is here
annexed.

<diagram> A Rep^r^sents y^e^ Catt made to twirle with=
out progression. B. progression onely
without twirling. and C. a mean of
both.

[181] As with several instances of the word 'prop' in the preceding section, all the words in this paragraph have been written in a larger script, it would seem for emphasis (as stated above, this presumably anticipating the kind of typographical highlight that would be used should it ever go to the press).

~~149~~ ~~cw~~.

Hence Wee have another rule In Mechanicks. vis^{t}
That If the direction of y^{e} body struck, will make any
tho y^{e} least way, & slowest, for y^{e} Movent to pass;[182]

Hitherto Wee have taken No Notice of the direction of
the body Impelling, but that of y^{e} Impelled onely, Now wee
Come to Examine what happen's to y^{e} former. And first
I Note this difference between one & other. the body
Impelled, (unless very compass, of w^{ch} I shall take Con=
sideration anon) /but being\ ~~but~~ of a ~~very~~ Compact forme, Never
is driven Into the hemisphear of y^{e} access, but the body
Impelling often passeth Into y^{e} hemisphear of y^{e} departure
And as to that, If it happens that y^{e} Impelled, doth Not
so, but Moves from y^{e} Contact to some point of the he=
misphear of access, It is Called Reflection, but If it pas=
seth into y^{e} hemisphear of departure it is Called
Refraction.

Now to begin with an Extream, let us suppose an
Immen's or If you pleas, Infinite Resistance at y^{e} Con=
tact, such as wee account y^{e} Globe of y^{e} whole Earth
is Against a tennis ball, or childs Marble. Here
According to Rule, the body Impelling, Reflects
with y^{t} same (or very neer it) swiftness as it Came
with. And the Surmounting obstacle or power at
The Contact, Receivs just, as it were, Nothing of Mo=
vement. So all the separative speed, ffall on y^{e}
part of y^{e} Impellent.

[182] This whole paragraph has been crossed out with diagonal lines, the word 'post.' in LH margin.

138v

cx

 prop. If a body falls upon an Infinite
Resistance, directed by y^e axis of access,
It shall Reflect with y^e same swift=
ness as it had. (fore.) and In the same
direction [Revolve?] It

As D. the body, Resisted at. C. Reflects againe to
D. with y^e Same swiftness. In w^{ch} proposition we Intend
a Globe or some body. so Regular that y^e axis, and
the direction /of y^e Impuls If it came upon D. [as?]\ are Coincident. but If the Case
be
obliq on the part of the Impellent, and If struck at
C. It would have any other di[183]

The body y^t falls upon an Infinite obstacle, Is Either
Regular, as a Globe or cube (when it touches by a
flat side.) or Irregular. and it falls Either without
or with turning. If it be a Globe, and hath No tur=
ning. It falls Either /directed\ by y^e axis of y^e contact-plane
~~y^t is direct~~, or Obliq.; y^t is by some other direction.
If it be direct as from D. to C. It must Reflect in
y^e same direction Reverst. but If it Comes obliq
Then it is to be Considered That, the direction from. E
 As in y^e figure, is not onely the direction
of y^e Center but of all y^e parts of y^e body
Therefore the whole, tends to proceed to. F.
But e force of y^e Impuls, tends to drive
it to D. As it would If the body were at. C.
and there struck. But the /contact\ opposition at. C. is Not [~~an~~?]
Equall ~~oppo~~ ag^t the tendency of all the parts. ffor that
must be

[183] Both paragraphs crossed out with diagonall lines.

must be done, by a Contact at. a. where ye tendency of
all ye parts had bin opposed Indifferently; and Nothing res=
ted Either way to Incline the parts to proceed in the ten=
dency of ye access, more one then another, but here the
propuls at C. doth Not wholly obstruct the parts a. & b.
from drawing ye body, according to the force of them, towards
f. Therefore the direction after the power of the stroke Must be Mixt
that is, determined by the power of ye Impedimt towards
D. and the [overpois?] of ye tendency towards. f. And the
buissness is to find the proportion or Measure of these
powers. & then I argue thus.

The obliquity of ye access, with ye Effect of it as to
the power at. C. is measured by ye Sine of ye Angle -
made between the direction or axis, D.C. and the direc=
tion E.F. then so Much power as is lost /in Effect\ by ye obliqui=
ty, Remaines In the body, to take from the Extreme
power at. C. and then the obliquity of the depar=
ture, will be ye Same with ye Obliquity of ye access that
is by Equall angle.

Hence Is that rule, that Angles of Incidence and
of Reflection are equall.

I know it is a Method of demonstration Much used
of late, ~~for~~ in propositions of that Nature, to Suppose
the direction of ye Motion to be a diagonall or Mixt
of. 2. Whereof ye Impedim't Stopps but one, then the
other prvailes. as in ye last figure but one. E.C. is Com=
posed of a Motion from E. to K. and from E. to G. and
this latter is opposed, so ye body must Come to ye line
E.K. In ye same manner as If it had Gone by. a.

139v

cz.

But this Is a way of proving I have No fancy too, Not
being scientificall, or taken from ye Nature of the thing
And least approved by mathematitian's who doe Not
approve, the synthetick way of drawing a case to an
absurdity, forrein to the Question. wee may Refuse to
admitt a line compound /or produced\ of 2 motions, but Say it is
on Simple motion; then for ought I see ye demon=
stration failes. And No authentick deffinition or postu=
latum, Requires any one to give such assent. If they
say whether it be so, or Not, ye line hath ye Same pro=
perty's, then I say, argue from ye property's without
Such supposition, and see what comes of it. that I aim
at, Intending to prove from ye Nature of things, so as to
create knowledg, as well as argue.

~~T~~There[184] are some Exceptions to this Rule of Equa=
tion of angles. the forst proves it sufficiency, & is this
If the ball turnes It break's all ye measures of it. ffor
If it turnes opposite to ye access, In ye order, b.a. the
Ang. of Reflection Shall be greater then ye ang. Incidenc[e?]
becaus the tendency In ye direction of ye Stroke, at the
point of Contact, /is\ disabled /by\ ye proceeding of the parts
b.a. back againe, and, so the direction C.D. gaines
Ground. this cheats many a tenis player, by Ma=
king a fals Reflection; And for ye Same Reason, If
It turnes with the motion, vist in ye order. a.b. then
the ang. Reflection Shall be less then ye Ang Incidence
The Reflection of billiard Balls wch is comonly just
doth

[184] The first 'T' had been washed out.

not Contradict this, becaus the Rolling of them is u=
pon No certein axis, but allwais varying, or Els, on one
paralell to the board, w^ch^ at y^e^ Side makes No distur=
bance, as a rolling upon a perpendicular axis would.

Another Exception to this Rule, is when y^e^ body that falls
Is Not Globular, and toucheth upon any prominency.
<diagram> so that the tendency of y^e^ parts are Not equally
all Resisted. as y^e^ body F. a parallelepipedon
touches an Infinite Impediment at C. With
a direction D.E. this shall not Reflect by y^e^ rule
and perhaps not at all but, by y^e^ tendency at E be
throwne Into y^e^ hemisphere of y^e^ departure, below A.B.
To have made a Reflection of that body, with an E=
quation of angles, y^e^ touch Must have bin at. [E?]. Et
sic deceteris.[185]

A third Exception is that w^ch^ destroy's y^e^ Rule, and all
y^e^ p^r^tended demonstration's of it that Ever were Made,
and that is that No Reflection is with an angle ex=
actly (as mathematicall demonstration holds forth)
equall to y^e^ Incidence, for there is No Infinite Resistance
for y^e^ Globe of y^e^ Earth Gives way to a tenis ball, Enough
to destroy a demonstration. Therefore that of Cartesius
and one of our M^r^. N^s^. w^ch^ follow's, are both lost.

<diagram> M^r^. N. supposeth a body driven into a fluid
& emerging. while under it moves In a line
parabolick, but Emerging Strait, & takes y^e^
same angle with y^e^ Surface as at Entring
It had; as y^e^ figure Rep^r^sents.

[185] i.e., 'and so the rest'.

140v

~~db~~./de.\[186]

But this I like wors then y^e^ former, for what~~h~~[187] hath our
proposition to doe with Immersion & Emersion?

In the Next place, wee must Consider the consequence
upon bringing y^e^ Resistance at. C. Into Compass. then
It will follow that, by how Much, y^e^ resistance at [C?].
yeilds by Making way, the ang ~~In~~ of Reflection,
made with y^e^ plan, lessen's, and If y^e^ Movent be much
Superior, It shall be but litle diverted and pass
on to some point In y^e^ hemisphear of the departure
with a direction broken at y^e^ Contact. And this yeilding
at y^e^ contact was y^e^ Subject first treated, where it was
shewed that equality majority, & minority made
the gross distinctions. the first by y^e^ Movent Resting
& y^e^ other moving with same speed, the second by
the movent Reflecting In proportion to y^e^ difference
of y^e^ Magnitudes, & y^e^ third w^ch^ is y^e^ p^r^sent ~~buissness~~
buissness, y^e^ movent passeth on with a deminish't
speed, in like proportion,and y^e^ other with that of
y^e^ Impuls.

<diagram> There are two sort's of Reflection, and both
are but different Reflection, and Must proceed
from obliquity of y^e^ access; for a direct Impuls
can Make no Refraction, becaus the direc=
tions of both body's are after y^e^ Impuls, on y^e^
same line, as /was\ y^e^ Movent before. as a direct
Impuls In y^e^ axis. E.C. never Refract's, and this is found
true in all optick Experiments. ffor y^e^ Sake of w^ch^
wee

---

[186] This is hard to make sense of - but it would appear that RN has here crossed out the first number, and then washed out the second number. Whatever the reason (or indeed, whatever it is that we can see), this shows that there were likely issues with the ordering of the folios; we find such corrections throughout this section.

[187] The 'h' has been washed out.

~~152~~ ~~de~~

wee labour this matter of Refraction, w^ch^ as I said is but
the Movent passing the plan or tangent of y^e^ Stroke Into
y^e^ hemisphere of departure, w^ch^ is done as I sayd 2. Ways
The 1. is the Case of single bodys, and the 2. the case of
Aggregates, and the latter onely concernes opticks.

As to y^e^ first it is onely when A body from D. Meets with
a feint Resistance at C. w^ch^ Removes towards H. and the
movent, goes on making a blunt angle at c. towards G
or some other point In that Hemisphere. but this as I Sayd
not being y^e^ Case of optick Refraction, and withall obvious
In y^e^ Sceme of movem^ts^ wee here Make, I say No More of it.

The other sort of Refraction is not of single but aggre=
-Gate parts, so that the tangent of the Impuls, Must Not
be y^e^ plan of one onely but of divers; Such as the sur=
face of water or Glass. And that Not seldome curb
as the prospective Glasses are. w^ch^ Curb is Composed of
so many severall [strains?] as there are particular's In
the operation, w^ch^ are too small to be Examined, there=
fore must be supposed; and at p^r^sent I Shall take it
In y^e^ circumstance of a planed surface, as water &c.^a^
<diagram> wee must Imagin
some forme, tho It
is not certein that
but w^t^ever y^e^ forme
is more or less a litle
one way & other
will amount to y^e^
same. as here

A.B.

[~~df.~~] dd.

A.B. is a Surface of a transparent body, whereof
y^e^ first order of parts ~~is~~are Globules, c.d.e.f. It is plain
an Inclined Motion, taking the the sides next to
the direction, are thrown Into y^e^ hemisphear, by E=
quall angles. as to G.h.I.k. and that Motion is
also Composed of divers coming with y^e^ Same di=
rection, whereof some falling upon the point of
y^e^ Globules, y^t^ lye in the superficies line, are re=
gularly Reflected to ang.= an~~d~~g Incidence. other's
are scattered to & fro, and some onely Refract Into
the body, and there pass in uniforme order as Re=
fracted light, but In greater proportion then here
may be Represented. Where note that I doe Not Sup=
pose that all y^e^ Movement Refracted shall be done
In one order of part's at y^e^ Extream surface, but also
Much In others next & Interior to them. and that
the Refraction is Never a single fracture of the
direction but divers. of w^ch^ More when I come to
consider the case of the light, the Most Recondite
& Complex of all y^e^ Subject's In Naturall philosofy.

In sume therefore, Refraction is Nothing but Qua=
lifyed Reflection, and that onely the comon effect of
body's clashing, by No other Rule then proportion
of substance, and Every Instance of Striking one thing
ag^t^ another, continually ever since y^e^ world began
(by y^e^ ordinary cours of nature, Miracles excepted)
done by that simple & plaine rule and No other
w^ch^ producing those admirable Ideas In us, /(as that of light & colours to say No More)
\ shews a
consumate wisdome in y^e^ Creation of y^e^ World.

~~153~~ ~~dg~~ ~~de~~

If this be so M^r^. Newton's solution of Colours, by a
Separation of ray's according to measure of Refran=
gibility, must fall. ffor wee admitt of No Qualitys w^ch^
are proved onely, by the fantasmes & Ideas of our
sence, w^ch^ wee know are not in but onely occasio=
ned by the things, whereof they seem y^e^ Images, as
was shewed In another place. And this Matter of
light & Colours, wee Shall also deferr to another
place, being y^e^ Subject rather of a Just treatis then
a branch of a philosofick Essay.

I have pretermitted one head, w^ch^ ought to be de=
clared, not as novel, but falling under y^e^ same
rule; but to p^r^vent Query's. It is proposed. And
that is attraction; W^ch^ differs in No Effectuall Respect
from Impulsion. as the body. A. being a Impedim^t^
<diagram> to y^e^ Movem'^t^ of. c. by mean's of y^e^ Cord &
hook b. Makes it move with y^e^ Same regu=
lation's as If It were impelled at D. by y^e^
same substance & velocity. W^ch^ case I state In a
direct regular Impuls, for manifestation, conceiving
Every other case with due allowances will be y^e^ Same.

But one might create many propositions concer=
ning attraction, and Resolve them Into our princi=
ples, as studious person's often doe for their owne,
and other's Exercitation. It is Enough for me to
shew the thing In gross, and If it be believed That
they are In all variety's Capable of Such Resolution
I thinck it Enough.

142v

df.

As If an annular body, be struck on ye Inner surface.
If a body be so Rams-horned, or crooked as No acco
can well be made of it, or otherwise deformed, one May
conceiv that ye termes of ye Substance given, and the
place of ye Impuls, It may be calculated, where ye Centr[e?]
of ye turning will fall, and where ye line of direction
Will be; and how much of ye body may be Considered
as Impelled, & how much as attracted; as for Instance
<diagram> the body A. altogether Irregular, is Struck
upon D. first the tangent of ye Contact
B.C. determines the 2. hemispheres. that
of the recess towards A. that of the depar[=?]
ture towards. E. and It appearing, that
much ye Greater part of ye body lying In
ye former, it is made to move In ye Way of attrac=
tion More then Impuls. that the attraction is by the
segment of ye tangent Intersecting ye body. and the
Impediment of the proceeding of ye part. E. accor-
ding to the tendency ~~of~~ ye stroke gives it, is by the
Quantity of ye part A. as If it had layne in a Counter
position, that is in ye same manner. as for Instance at F.
And then a New center, Emergeth, by wch the direc=
tion is to be Made, and ye obliquity of that to the
tangent B.C. determine how much shall be [Sunk?]
by turning, and how Much left for progression. And
thus the Case admitts a Calculate If any used to Such
practis would undertake it, by /ye means of\ Quantity's known /or stated\ in
/practick\ measure & position, and accordingly I leave it to them.

~~154~~ ~~dg~~.

It is to be observed that the Moderne Naturalists
have taken estimates from apparances resulting from
Complex Effects, without Reducing them to simple ones
by w^ch^ onely they are to be Judged; And one error Entered
on this occasion, I have shewed, vis^t^ that ang. inci=
dence is Exactly equall to y^t^ of Reflection, w^ch^ is Not
true: I mean mathematically; And those demon=
stration's p^r^tended of it, being Not ~~taken from~~ /drawne from ~~founded upon~~\ the
Nature of y^e^ thing Scientifically Misledd them, being
also fallacious In themselves. I have one More as
Gross as that, w^ch^ I wouldexplaine. And that is

Of the Recess of body's from y^e^ Center of a Compass
movement, by mean's of a rectilinear direction In
a tangent, Where it is alledged that a body de=
teined in such a movement shall at y^e^ Instant of
y^e^ freedome, be determined to Move In y^e^ tangent. W^ch^
Is Not true In that generality, but onely as it falls w^th^=
in y^e^ Comon rule if direction upon Impulses.

<diagram> As let y^e^ body C.D. of y^e^ forme Exprest, be
deteined at C. In a compass motion from C
towards. B. and set free at. C. I say the body
Shall Not Move In y^e^ tangent (for I goe
by y^e^ center) a.E. but Obliquely from y^e^
contact toewrds. D. More from y^e^ center
then is y^e^ tanget. a.E. ffor at y^e^ Instant of freedome
The case is as of an Impuls upon y^e^ side c. and then y^e^
point c. is y^e^ point of Contact, by w^ch^ & y^e^ Center of
y^e^ body shall be the direction, without being tyed to
y^e^ tangent. But It must be admitted that ordinarily
body's being Covered on one side by y^e^ deteinemt

of

dh.

of them. and then the rule of direction is Coinciden[t?]
with y^e tangent, w^{ch} they have taken to be the rule
it self; Judging by y^e frequency, & from thence the
comon appearnce, & Not y^e Nature of y^e thing. as May
<diagram> be Instanced according to these diversitys of
figure, w^{ch} May well $Repy^{r}sent$ y^e Generality
that produce such effect.

But I am Not Satisfied that any, or rarely
Irregularity's will bring a body Neerer y^e Center then
the tangent tho Many may send them farther. lett us
<diagram> suppose a body of this shape; deteined at the
points D. & B. of w^{ch} a medium point A. is
the contact. and that drawne to y^e Circle, falls
at C. or the circumference of y^e Motion May
be thro A. then the direction A.E. will fall
neer If not In y^e tangent. A.E.

Or suppose a body of this forme, deteined at y^e arch
<diagram> D.B. /say\ y^e point of contact is. C. according to
that, y^e body should goe off by C.F. w^{ch} will
not happen. and the reason is, tho y^e body
were Glued to y^e Circle at D.B. yet the Im=
puls is as If it were at D. and then D. is
y^e Contact by w^{ch} and y^e Center. A. gives the
direction D.A. /as will happen\ More towards y^e Circle. but admitting that
It doth Not take a way y^e Recess, for Every rectilinear
Motion must Receed from a center. therefore the Recess
from y^e Center may Increas according to y^e power of
Matter, but Never wholly, or scarce Ever Much deminish

Thus frail is it to make hypotheses, out of appearances
without going to y^e Mechanisme of them, as M^{r}. N. doth With
his $vira^{e}es$, centipetall centrifugall, attractive and aversive &[c?]

~~155~~ ~~di~~.

The Next matter wee have to declare, leading to
practise, is the consequence of divers Impedements
or obstacles to bodys In Motion, /besides\ that of Immediate
Impuls. Concerning w^ch^, I first observe, that when di=
vers body's are contiguous, and one is touched, the
Influence of the stroke is conveyed Quaquaversum
ad Infinitum;[188] And very often body's are Made to
move as well directly opposite too, as conforme
with the direction of the first stroke. as If A. Strikes
<diagram> B. or any one of y^e^ Contiguous body's. C
E.D. Every Other of them are moved by
y^e^ Influence of y^e^ Stroke, and how small
or Numerous soever, by No other rule
then hath bin touched; vis^t^. Every one by
contact on some part of it, inclining it to Move as
If y^e^ first stroke had bin there; and however a Confused
effect this seems to have, by Scattering small body's
about Every way, yet in truth No one of them but
is moved by y^e^ Rule of Impulses as stricktly, as y^e^ body
B. when struck by A. So that Every /seeming\ Confused Effect in
Nature is Reducible to the rigor of those rules, If Men
had mean's by capacity & knowledg to doe it.

<diagram> And that by a stroke y^e^ Influence may
come round appear's by y^e^ line thro y^e^ Cen=
ters of these Globules. by A. upon. B. C.
D.E.f.G.H. In y^e^ order & position as they
ly. But much more in cases of irregulars
thro w^ch^ onely Imagination, & that scarce can track
the Infinite path's of force conveyed by these various
contacts

[188] i.e., 'in infinite directions'.

dk

contacts & centers, as are found amongst them. All w^{ch}
leads to conceive the posibility of many actions
In fluido.

If a body falls between. 2. and strikes them So
that according to the direction given them, they
moving shall make way, tho the least & slowest
Imaginable, they shall separate accordingly, In case
sufficient force is added to Recompence the disad=
vantage of the striker. As the body A. Moves be=
<diagram> tween B. &. C. and at the Same
Instant toucheth both in y^{e} points
a. b. I say the body's shall move
towards D. &. E. Each on its owne
direction. whereby way shall be
made for A. to pass. but the y^{e} Mutuall forces
are to be Considered. If the obstacles a. & b. are
Extream, then A. for want of force cannot pass
but shall be Reflected from y^{e} place G. back again
for the reason's In y^{e} Case of a less body striking
a greater. It being y^{e} same thing whither the touch
be on one point or More, the medium point is ac=
counted y^{e} Contact.

But admitt y^{e} obstacles moderated, then If the ce[=?]
lerity they take is such or more, that the parts of
y^{e} body. A. In passing, touch No More, then the Who[le?]
Effect is as upon an Impuls In an Instant. but If y^{e}
body B. &. C. are so stiff, as may /be\ by an over mak[..?]
ing Quantity, that they tke a slow Motion, the[n?]
it is Necessary to add force to A. at G. or it Cannot
pass

~~156~~ ~~dl~~

pass; that is Increas y^e magnitude of A. or demi=
nish those of B. &. C. and that supply's the occa=
sion. And this Rep^rsentation shews, by y^e figure of
a Comon wedg in practise, that y^e force of an hea=
vy, or massy maul, added, w^{ch} doeth ~~wedg~~ wonders,
wherein wee must take notice, that the force of y^e
obstacles at a. &. b. from the obliquity of their
departure, makes them have less force then their
Quantity would directly allow. And so the Wedg
were it of a sharper forme at y^e angle. f. by
Increasing that obliquity, would Still gaine ad=
vantage. as In y^e forme A.B. the body's C. &. B
<diagram> must open; and but the length
a.b. while y^e wedg passeth
the length A.D. so that a Slower
motion of C. &. D. will Reconcile the passage,
of A.B. then, If the obliquity were less, and it
taking less force, to give a slow then a swift Mo=
tion, y^e Wedg by that hath y^e advantage. more of
this when I come to Consider & Enumerate all sorts
of Mechanicall powers.

But that w^{ch} is Most Considerable, In y^e Conside=
ration of y^e former diagram, is that onely Rever=
sing y^e proposition, and by the Consequence ~~that~~
Strang Effect's are Reconciled. ffor suppose that
the Motion was In B. &. C. upon the Body G.F.
striking it upon y^e points a. &. b. In the same
Instant. as before the wedg devided them, so
those

dm

those Now drive out ye wedg, as will be Manifest
from ye reason's often toucht of Reversing the
termes of Impulses, wch Makes no alteration of ye
Effect, but with Relation onely to ye by standers.

Another /consequence\ is from hence, that If any body upon
wch a stroke falls, or by any mean's Moving
should make way to ye Influence of ye Stroke, for
thing's to pass in their direction; It shall Move
In case the movent have force Enough to sur=
mount the difficulty from ye oblique position, as
<diagram> let C. be an Impediment of power
Infinite, agt wch. ye body A.B. Rests.
And an Impuls falls, upon. D. If it
have force Enough, it shall force
A.B to Move In ye direction B.A.
so as D. & C. may come together.

Another Grand theorem Results from all that
is Gone before, is that when forces any way op=
pose one and other, (ceteris paribus)[189] ~~If~~ one moves
with a greater swiftness; that hath the Greater
force, and Shall prvaile against ye other, wch is the
onely roots and foundation, whereon ye Reason
of all Mechanick powers depend, as will appear
In due time.

Another great rule In Mechanicks, /from hence ~~is~~\ ~~(~~Not Much dif=
ferent from ye former, but in termes~~)~~,[190] is that In all
application of powers one against an other, time
is equivalent to force; If you gaine in power you
loos in time, wherefore few machines are of any
great

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[189] i.e., 'all things being equal'.

[190] The word 'is', and both of the brackets, have been partly washed out.

146r[191]

~~157~~ ~~dn~~

I Shall next persue, this head of Mechanicall powers
That have foundation upon the last observation and
Rule, Concerning w^ch^ it Needs onely be Remembred, that
By the Effect wrought upon Impulses, whatever Quan=
tity the body Striking (w^ch^ wee shall Call y^e^ force)
had, as the velocity was Increast, so a proportio=
nable Increas of Effect appeared in the body struck
w^ch^ wee may Call the weight. as If equall Quantity
Gave ~~Equall~~ swiftness, double velocity In y^e^ Same
Quantity gave double; that is still its equall, so
If half Quantity Gave half velocity, then dou=
ble ~~Quantity~~ velocity In y^e^ Same Quantity, Still
doubled what was before. So wee say also of Quan=
tity, and it shall give equal velocity, to y^e^ other
doubled. & so In all proportions; Whereby as M^r^
Newton expresseth, double velocity In double Quan=
tity is Quadruple.

Now the Essence of the velocity is, the passing ~~Grea=~~
certein space in certein time, and Comparison of
velocity's is the comparison y^e^ Spaces past by ~~y^e^~~
divers body's In y^e^ Same time. Now If by any Con=
trivance it is brought about, that body's oppose
one and other In Movement Reciprocally. that
w^ch^ moves Swiftest ceteris paribus hath most force.
that is If y^e^ Spaces run by Each are unequall that
w^ch^ runs y^e^ most in y^e^ same time hath most force &
shall p^r^vaile.

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[191] Although the numbering is continuous, this is clearly a different version of a similar work. Note that there is no continuity from page to page; the hand-writing is slightly different (later?).

do.

Shall pʳvaile. as In a single Instance, A=B. And Moves
 towards B. with. 1. grad. ~~force~~ /swiftnes\. and B. Moves
towards A. with 3. grad Swiftness, so as they
meet & clash In. 3. the rule is that these
body's Counterchang states, And A shall be driven
back with 3. grad, & B. follow with one. Next take
am Instance of opposition by a medium. let A.=B.
 both move agᵗ an oblong body, agᵗ wᶜʰ an
Infinite obstacle bears. If yᵉ obstacle bears
upon yᵉ Midle, and yᵉ body's both fall on yᵉ
Extremity's at the same Instant, as If yᵉ obsta=
cle is at 2. then the body's Shall both Reflect
back with all their velocity. for yᵉ opposition is on
Either side Equall, & neither can pʳvaile; So It amounts
to a falling on yᵉ Infinite opposition both Imediately
& at once. But if yᵉ obstacle be at. 3. so as 3. parts
of yᵉ barr, ly on one side and 1. on the other. Whereby
(Circles being as their diameters) the barr Moving
agᵗ yᵉ obstacle at. a. or. 3. the point D. shall Move
with a velocity to yᵗ of yᵉ point C. as 3/1. Now If yᵉ
body A. Rested on C. and were (Quasi) Struck by B. on
D. 1/3 of velocity would take away yᵉ Resistance, & Make
way to yᵉ force, that is A. by moving 1/2 of yᵉ ~~loe~~ velocity
B. from D. amy proceed without Impediment; So C. Can
caus No More Swiftness In. A. then so Much as is Necce[=?]
sary to take away all Impediment. on yᵉ other side if
B. Rested or. D. And A. struck it, upon. C. B. Must
move with triple the velocity yᵗ A. had, to take away
yᵉ Impediment. And A wants of that power. 2/3ᵈˢ . Ergo

according to this posture, A hath ag^{t} B. power
but as. 1. to. 3. Consequently both striking at once
the power of both are in y^{e} proportion. A. 1. & C. 3.
wherewith y^{e} Consequence agrees, ffor the bodys can=
not Move in that posture, but y^{e} velocity's will be
as. 1. to. 3. And whereas A wants 2/3^{ds}. add, Quantity
to A. vis^{t}. make it triple. and then that with ve=
locity. 1. is Equall in force, to y^{e} other with velocity
3: & so this comes to a ballance, or equilibrio. And
Hence is all the Rule of staticks, w^{ch} is y^{e} Art of
proportioning things by weight. ffor Weight is accoun=
ted as a comon velocity all body's have /ad Normam perpendicula[192]\ & then y^{e}
ballance proves their Quantity; as authors of Staticks
Declare.

This art of ballance is so Much of use, and clearly
understood by so few, I shall add a few lines of it.
There is but 2. sorts of Ballance one with Equall &
y^{e} other with unequall armes, or Extents on each side
y^{e} Center or prop of it. The Equall beam, as it is
called, is but of 3. sorts 1. that w^{ch} shall be in Equi
librio & Stand however y^{e} beam is Inclined, 2. that
w^{ch}, put out of Equilibrio shall Returne to it. 3
that w^{ch} put out of Equilibrio shall Neither Returne
Nor Stand, but fall Into a posture perpendicular.
The reason of w^{ch} differences is founded upon y^{e} placing
3. centers. one y^{e} prop of y^{e} ballance, & y^{e} 2 others at
each end one, whereat y^{e} Scales are suspended; for
those allways perpendicular from their points or
centers

[192] i.e., 'to the perpendicular norm'.

dq.

centers. In the first case, all three points are Exactly
In a line, and equidistant from ye prop. ffor so put
<diagram> ye ~~peam~~ beam In any posture levell or
Inclined, the weights hold Exactly ye
same distance from ye perpendicular.
wch must Ever Equilibrate.
The 2d. case is when the points lye below ye prop.
<diagram> ffor so ye beam put out of level. one
End carry's its weight from ye perpendi=
cular, & ye other brings it neerer. as
ye Draught shews; but scale makers have
2 way's of making this Effect In ye beam
that it shall stand allwais levell, and yet ye points
be in a true line, wch is ye onely true weighing. and
one is by charging ye Metall or substance of the beam
most below ye center of prop, then when ye beam is
<diagram> put out of level, More of ye Substance falls
on the rising side & Reduceth it. so that
ye beam is as it were pendulous, and Will
hold its true perpendicular. ye other way
is by ye forme of the center pin, wch being of ye Shape
A. almost like an heart, takes equall distance
<diagram> from ye points onely In ye level posture, & ye
mucro[193] is In perpendicular according to ye
length. as here. at A. for If ye beam be put
out of ye levell & Inclined, the Mucro of ye
pin run's to ye Rising side & Carry's the Met=
tall of the beam that way wch Reduceth it
to ye levell againe. This way is Most used, When
the

[193] i.e., 'edge'.

~~159~~ dr.

the level Makes weight, as In troy Weighing, but
when the weight is to sink the centers & mettall
ought all to be Exactly Equall. that is aver-du-
poids, as y^e^ word Imports.

The 3. sort is where y^e^ centers of y^e^ armes, are a=
bove y^e^ center pin. that Inclining y^e^ beam, Carry's
<diagram> y^e^ falling farther, & y^e^ Rising neerer
the perpendicular, w^ch^ carrys it
downe apace.

This cannot be a ~~true~~ /fine\ scale, & other's /more\ fals are Con=
trived, as unequall armes of y^e^ beam, and [paysed?]
In y^e^ mettall. but that, and whatever fraud May be
used in a beam & scales, is corrected by weighing Cross
as they Call it. that is changing y^e^ weight to y^e^
Goods & 'E contra; If y^e^ pois hold Not, y^e^ Scales are fals.
Therefore it was a vaine project set on foot, for
Reglating, & sealing beam's; for accidentall falls
& Injury's Might Make them fals, and weighing Cross
allwais discovers it. so a scal could Never assure a
true beam, and Every one has a ready Mean's to
Ensure against a fals one.

The other Sort of Scale, Called a stillyard, is a beam
with unequall armes and y^e^ weight is Increast Not
as In y^e^ ballance, by addition, but by moving y^e^ Same
weight farther from y^e^ Center pin, for w^ch^ is adjusted
by Notches on y^e^ beam for account, farther from the
center; and y^e^ truth of this In y^e^ Making & adjustm^t^, w^ch^
is Manufacture; so here I acquitt the ballance.

ds.

Artists account. 5. Mechanicall powers, meaning
such comon methods as workmen use, in lifting &
disposing Imens weights, and accomodated to divers
occasions. The wedg, & ballance I have touched; the
lever is Coincident, having the same reason as a
stiliard. vis^{t}. as the spaces, or arches at each end
(y^{t} is y^{e} Space In w^{ch} y^{e} weight Moves, to that In w^{ch}
y^{e} power Moves) are to Each other so is y^{e} power to
y^{e} weight; and needs No farther Illustration. The
other's are the Axis in peritrochio,[194] the screw, &
y^{e} pulley.

1. The axis In peritrochio, here described, is but a
<diagram> perpetuall lever. where A. is y^{e} power. C the
weight. & B. y^{e} propp. w^{ch} doth Not Come to
a stop as a lever doth, but by turning on
y^{e} Center pin. B. is Ever y^{e} same, and hath y^{e}
same continuall advantage to y^{e} force ag^{t}
y^{e} weight. as y^{e} circle A. to, y^{e} axis. C. or as
A.B. to B.C.

The screw they analise, by saying it is a wedg
turned about a cilinder; and so Resolve y^{e} force it
hath; w^{ch} I doe Not dissapprove, for it must fall upon
y^{e} Very same reason; but y^{t} doth Not So clearly sa=
tisfie y^{e} understanding, as by Shewing it with an uni=
<diagram> versall rule w^{ch} accounts powers by time or
swiftness as well as by Quantity or weight.
The screw is ordinarily combined with a double
lever as In y^{e} figure. then Compute the way
the hand that turnes at A. Moves. to y^{e} space

[194] i.e., 'wheel and axle'.

the weight riseth In y^e^ Same, and so is y^e^ advantage
on y^e^ part of y^e^ power by y^e^ Mean's of y^e^ Screw.

The last is the pulley, w^ch^ is analised, by shewing
that a single pulley is a perpetuall ballance. and
gives no advantage at all. then a pulley below
Is y^e^ like, onely y^e^ weight plac't at y^e^ center and
y^e^ props at Each End. takes off half the weight, &
<diagram> hangs up y^e^ other half to y^e^ propp of y^e^ upper
pulley, Then y^e^ cord passing another pulley takes
aloft yet~~t~~ Nothing but Every lower pulley takes
of Half. y^e^ Manner of w^ch^ is at. B. And thus with
4. pulleys 2. aloft &. 2. below is made that
they call a double tackle, a single tackle hath
but one pulley below. Thus they Endeavour to Make
y^e^ force understood, w^ch^ is done much clearer and
plainer by saying No-more, then as the Cord w^ch^ In
working passeth y^e^ hand, to y^e^ space y^e^ weight. vis^t^
as y^e^ spaces, &c. moved in y^e^ Same time.

Now these are the ordinary applications for acco=
modating occasion's; but these may be combined, &
other sort's Contrived, If need were, ad Infinitum,
so long as the power can get a longer walk
the the work, so Much purchas as Seamen
say (and No other speech in y^e^ World affords a
word for Mechanicall powers) is gained. And the
Gaine is great when y^e^ force is Gratis, as Wind
or water; or /where\ Men /Enough\ cannot Come to handle things /& work\
/All\ w^ch^ Engin's doe, tho In longer time. but If the

du.

thing Requires Men's labour, /& they Can Come to work\ No Engin like ye armes
of a Man; there is No rubbing Nor breaking; So yt
a man, by his Naked hands, Shall doe more work
In less time, then he Can /doe\, by any Engin, for those Will
all sell their work for time. And where ye force is payd
for by account of time, small profit is made of engins.
I should say more on this delicate subject, but It is so
well done In Dr. Wilkins Mechanicall powers, It were but
actum agere.[195]

What was say'd of a Wedg is Not forgot, to wch Rest's
to be added onely an acco of what ye Dr hath left in
Incerteinty yt is the force of blow's, as ye way is of wor=
king upon wedges with weighty Maulls. That is onely
ye effect of substance, with addition of velocity of its
Gravity, called weight; but If let fall from an High
place upon the Wedg, It hath a velocity actuall wch
In such substance, is great force, but to that is added
double or treble velocity by ye force of Men's hands,
wch augments ye force accordingly. There Might be a
Machine to Measure ye force of blows, by wch the
Whole Rule of Impulses, might be proved. the way
of striking upon one arme of a beam, with a weight
on ye other, is not comodious, becaus you strike agt
ye force of gravity wch disturbes the acco. for In Ex=
periments of Motion all Gravity must be Removed
as also Rubbing. And this Cannot be so Well done
as by Suspending vast weights, & then striking them
laterally. ffor ye Magnitude takes away the Impe=
dimt

[195] John Wilkins (1614-72), polymath and cleric, published *Mathematical Magick, or, The wonders that may by performed by mechanical geometry: in two books, …*, in 1648 while still chaplain to Charles Louis, Elector Palatine, and in the same year that he became warden of Wadham College, Oxford. He supported the Parliamentary cause. He married Oliver Cromwell's widowed sister and was promoted to Master of Trinity College, Cambridge. He was a key mover in the early days of the Royal Society. Despite official disapproval after 1660 he slowly advanced within the Restoration church, in 1668 becoming Bishop of Chester. He was widely respected on both sides of the political divide. *Mathematical Magick* remained a popular book, and was republished in 1680, 1691 and 1704. The Latin phrase '*actum agere*' means 'already done'

~~161~~ dw

-diment of y^e^ Medium, and also Makes slow Movem^ts^
w^ch^ May better be accounted, and the long radius
Enervates y^e^ force of Gravity, In short swing's, as was
observed.

Now as to Engin's In generall and the Rule, here and
Every where p^r^scribed. for calculating their force, I Shall
set downe some observation's, and Experiments, ffor
clearing y^e^ Matter to y^e^ plainest capacity.

It is comon ffor the coursest labourers, If any thing
heavy be to be wrought upon, to Get ~~heavy~~ /weighty\ loggs to
drive with, as plum'ers, masons; &c. ffor a light
thing can scarce have force by any Swiftnes put
to it, sufficient to Remove weighty things.

The Rule of Waterworks, is y^e^ proportion between the
diameter of the force, and the diameter of y^e^ vent.
<diagram> and as y^e^ vent is less with Respect to y^e^ tube
of y^e^ force, more power must be added to doe
y^e^ same work; becaus the water must be put
in so much greater swiftness. ffor an Inch
water at y^e^ force, may be 10. inches at y^e^ vent
and therefore must move swifter as 1/10.
<diagram>
Take an Hunting horn, an press y^e^ Mouth downe
Into water with y^e^ small end upright, and the
water Shall spout up strangely, & be No small
surprise. ffor the mouth takes in a larg diame
ter and y^e^ small end dischargeth ~~but~~ by a
very small one. so If y^e^ force of y^e^ hand be added
so as y^e^ water shall rise rather then y^e^ Mouth put
it by, In y^e^ small part of y^e^ horn it acquires Swiftness.

150v

dx.

The sence by mean's of the armes & hands Mana=
ging things is Egregious, tho /as to account\ Not Exact, and the
power of body's /striking\ upon one & other may In great
Measure be proved so. As If you take 2. wedges
and swing them In Hand at armes End so as to
knock their heads together; If they are Equall,
It will be perceived that one hand takes the Mo=
vem't from ye other, wch shall Rest. So If one be
greater it shall follow, If less Reflect. And as ye
odds of Quantity is, so shall ye Symptomes be More
Notorious; wch so plainely perceived, will Need No
farther demonstration. that ye degrees of Quantity
proportioned to Each other, governe ye Symptomes. &
to Say truth, Nothing that Consists in Event, is pro=
per for rigorous demonstration, as existant Quan=
tum's are; for futurity will have No degrees of
proof beyond utmost probability; as for ye Suns
Rising, however probable, there can be No demon=
stration.

The action of a Coachman's long whip, is Remar[=?]
kable, how such an Incredible swiftness should Ga=
ther at ye small end, as to break ye skin of an ani[=?]
mall. but when it is Considered, that the strength
of the arm sends a force, to ye fall, wch lessen's Conti=
nually to ye End, and the materiall taking a
bow or loop, ~~and so~~ ye force passeth into less Matter
at ye Small End becomes so very Swift.

It is diverting to see a long cart-rope, layed out
at length, and one End taken up & with an hard
stroke

~~162~~ dy

stroke, & layd downe, there shall be an arch of y^e^ Rope
pass along most deliberately, according to y^e^ big=
ness of y^e^ Rope to y^e^ farther end, as If it were a
<diagram> pipe y^t^ conveyed somewhat. the Man=
ner is here Represented. where y^e^ arch
a passeth along from b. where it is first set going
on to. c. where it goes off. Now If It were so Contrived
that y^e^ Rope lessened towards. c. y^e^ arch Would Mend
its pace, and Contrarily ~~widen~~ being greater, Slaken.

The demonstration ag^t^ a perpetuall Returning Mo=
tion is this. It must be done, If at all, by making
forces /In themselves\ Equall /by Mechanisme to\ become superior. becaus that w^ch^ is
Ever to Returne must take all places, and be some
times superior & sometimes yeild. for If there were
Not this Returning, If way were made, Wee Should
find No End of falling; & that Might be a perpetuall
motion. but the Earth stopps that; therefore whatever
is y^e^ principle of y^e^ Movem'^t^ must work & be wrought
upon alternately & Continually, w^ch^ can be by No
means proposed but by equall power's Mechanically
disposed. The Equall In force, Cannot be superior
In effect, without more swiftness, & consequently is
Removed farther from its place; the same is ~~made~~
sayd of y^e^ Next & y^e^ Next, whereby the Returning
failes, and It becomes continuall progression till
It Meets a stop. If the Equalls are Not so made su=
perior, the machine Must Necessarily Rest.

151v

dz

The Grand tides of y^e world, May owne a great [...?]
to this principle, ffor a small rising In y^e ocean, when
It Comes with such a body of water, among shoals &
Creaks, by Contracting y^e body, It acquires a celerity
w^ch carry's it up Into country's, In height 40. to 1 of
the Main ocean, as y^e patterne of y^e Horn In Water Shews.
Nor doe I thinck M. N. so much in y^e Right that accu=
seth Cartesius of an Error, in supposing y^e /Inter\ tropicall
ocean, to sink under y^e Moon, whereas, say's he,
It swell's, being attracted by y^e Moon. Now If y^e Judgm't
be made by coasts & Rivers, tho In y^e Intertropicall
Region's, there may be gross error. ffor If y^e sea be Com=
prest it is where it is deepest, ~~and~~ for there y^e wave
Can play, and Not on y^e shallows. And who Can tell
whither y^e water In y^e atlantick deepen's or shal=
lows, under y^e Moon? or What time y^e Wave takes
be it Either way, before it Influences y^e Rivers?
who Can tell but it may be a succession of divers
and Not y^t one wave onely possesses y^e whole sea
and all[~~..~~?] y^e Coast's and creeks. It is 6. hours rising &
falling at y^e Mouth's of Geat Rivers, who can say
that is the same 6. hours y^t It riseth & falleth in
y^e Main. As y^e Wave of y^e lord was, so are Comon wa=
ves, on y^e surface of y^e water, and y^e Grand wave y^t
is y^e tide, Not a Current but rising, and falling ~~onc=~~
~~ly as the~~ /by meeting shoals & creeks also\ Contracting, onely makes a Current; W^ch
may be seen in y^e Samll channells, neer y^e Mouth of
a pool; but It is a dignity, as I perceiv, to blame
& affirme, Els learned men Would Not so Much affect <u>it.</u>

principles[196] .1.

In the designe of Establishing principles of Naturall
knowledg, I think y^e best method is. 1. to Consider what
certeinly is, and under that wee find by Indubitable Evidence
that Body Exists, being that w^ch will part with No grain
of its Extension, but holds it's limit's one way or other, with=
out Increas or deminution. I might have first sayd with
Cartesius, that wee are sure wee perceiv; but that is
allwais p^rsupposed, whatever we discours of. So I pass
from the thing to the manner. And as to that wee find Much
variety, ffor object's appear to us very different, some Small
other's larg, & y^e Same object often both way's, & some=
times hott, and as often cold; some Resist some yeild
& in all degrees; Some Sound, other's Not; Many have
light attend them, others black, or dark; & when Com=
mon light shines, most thing's are coloured and with
much diversification; Some appear to Increas or grow,
other's wast, & dissolve or Corrupt; wee are much plea=
sed with y^e Elegance of some, w^ch gratifie us, as flowers
fruits, Green's, & the like, as well as Nourish, for w^ch
reason's wee desire and Covet them; other's are offen=
sive In Extremity, as ordure & the like; And some If
admitted Into o^r body's, destroy us, as poysons. And other
variety's are, w^ch are past o^r skill to Enumerate. And all
the fruits of our proof and Experience; w^ch withall
gives us Such direct Indication's of our mistakes
of all these things, as makes it Necessary to Reject
them all from being accounted principles. ffor such
must subsist of themselves, and furnish Causes, of
these changes & variety's, and Not these of them.

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[196] The title of this section squares up exactly to confront Isaac Newton's *Principia*.

2. principles

ffor as cartesius hath pʳmised, and In yᵗ all follow him
or at least In most Instances, that all these Images
are flux, and changeable, Something wee Remember
and then dream, often are decieved by taking one thing
for another; fancy lyon's in yᵉ clouds, & as Whitting=
ton, language In yᵉ bells. Wee have No reason to look
out of ourselves for them. But thus wee Argue, that
the various pʳsentation's of objects to our senses, doe Stirr
up or Caus these Images in us, ffor they Constantly doe
it In some sort or other; so that however these Ideas
are within us, the caus/es\ of them are without us. Then
wᶜʰ way should ~~then~~ wee find the true distinction of
what is wholly within, & what wholly without us?

As to that I thinck, yᵉ Method I propose In other In=
quiry's, that is to Examine things not exquisitely In
the Examination by mean's of oʳ facultys, by the a=
nalogy of thing's that are so is Best & surest. As for
Instance a sword Run Into an arm, is one sort of
paine Into yᵉ thygh, another, Into the Eye, cheek, or
neck yet otherwise; yet all from one and the Same
sword! so it is certein these diversitys of paine, are Not
in yᵉ sword, for that is allwais the same. So When a
Battoon falls upon our flesh, & makes Contusions
It is yet another sence then yᵉ Sword Gave, and as
the stroke falls upon our flesh, & makes Contusions,
It is yet another sence then yᵉ Sword Gave, and as
the stroke falls on severall parts & member's so yᵉ
sence, be it painefull or Not is perpetually diver=
sifyed, as all other manner of attaques upon the
sence

sence, however various the Instruments & mean's are, are
all accordingly diversifyed, as as wee know most of
our sensations, digest 'em into heads & Give 'em
names, & subdevide them to accomodate our signi=
fication of them In discours. as all that Touch us upon
the Eye, whither ordinarily, or otherwise by Gross
strokes, well call light, & subdistinguish it Into Colours.
So upon y^e timpanum, for Sounds, palatt for taste, &
all y^e rest of y^e body for touch; And In all this that is
within our Scrutiny wee are certein the Images of sence
caused by Externall objects is Not In y^e object, but In
the fancy. As the pain of Thrusts & blows, w^{ch} doe
Egregiously affect y^e sence, Impressing y^e Image of pain,
is Not In the sword, or Cudgel; tho those Caus it. And
How? by parting the Continuum of o^r flesh, & vessells
or membranes, and breaking y^e tone of y^e parts by
brusing, that is In short by the Motion of them. And
since This is so Notorious In these Instances, why should
wee goe farther for understanding y^e means of light
sound, tasts, &c. tho y^e body's Causing them, are not
In our power to Scrutinate? But Surely it is reasona=
ble to beleev, that /since\ divers paines are caused by y^e Mo=
tion of Gross body's falling upon our members, other
Nicer sensation's /as vision for instance\ are Caused by some Motion of or
from body's y^t affect our sight, and diversifyed ~~by~~ /according to\ y^e
modes of those action's, by y^e forme & Image wee have
of light and Colours; or Why should wee argue light
or Colour to be in y^e object, More then pain in the
Sword or Staff; so also of sound /from\ ~~In~~ the ringing body.

4. principles.

So having fixt these points. that possession of the place, wch
wee know under ye Images of Resistance, hardness, and
fullness, wch can never be devided from body, and Carte=
sius thincks is ye onely Essence of body, tho all other
property's, as colour, tast, smell, heavy, light, &c May.
one principle ~~is Gained;~~ concerning things without us
is Gained, vist. Body filling place; wch wee May Style
Extension, Impenetrability, or otherwise as words May
flow, but allwais Reduc't to this sence of filling place.
Then wee find Nothing true of body Extra to us, but that
it is here & there, and passeth from one thing to another
sometimes saluting us civilly and agreably, & Sometimes
rudely & painfully, and wee with our owne body's have
like complements for others. wch gives us an Idea of
Motion; And that is a subject Nicely to be weighed
becaus wee can find No other diversity In that Mate=
riall that works In us so Many various Images, as
wee have thro our comon organs of sence. So as to all
causes of our knowledg without us, wee have No
principles to build on but. /1.\ Body, wch wee May call
promiscuously parts, corpuscles, lumps /~~parts~~\ particles, or ye
like occasionally. and 2. Motion. Wch I Shall Not
account any reall Existence besides body but onely
a Mode of body, with Respect to distance /and position\ among
divers ~~from~~ /Respecting\ one and other, and In single bodys, Res=
pecting the parts of it. And otherwise that there is
No Essence In Motion, What Wee Call so being Not a
Reality of it self but a Relation of one thing to a=
nother, then there Will be but one onely principle. Body.

principles. 5.

I know this discours will be sayd either to be
very ordinary & comon, No rarity, and w^ch^ is was
fall under y^e^ Censure of those who treat such as /doe Not\
like themselves rail & Revile all that Cartesius
brought forth, bestowing y^e^ title, of those men, and
perhaps, those gentlemen, with a scoff, upon them,
who are so used to triumph ~~over~~ In Collegiate lec=
tures, as they pleas, ~~and~~ /they\ cannot forbear In print
the shewing a more then tutoriall Arrogance, In=
sulting their better's, nay, benefactors, for so was
Cartesius Whose Methods & notion's one may trace
Even in their haughty language against him;
but be it my tutor, or Cartesius, amicissima ve=
ritas,[197] & wee will Neither decline Nor Quarrell any
reason or truth for y^e^ sake of Either, Neither uphold
any thing upon any authority but that of Reason
according to y^e^ light wee have. And Whither the
late Author hath observed this golden Indifference
or Not, fixt libri Indices,[198] where it appears, that
It hath bin y^e^ drift of his whole undertaking, It
may be of all his philosoficall studys, and he failes
Not on all occasion's, Especially y^e^ Main hinges,
tho /will\ very seeming temper & Couchant,[199] to Confute
and depreciate all that Cartesius brought forth.
W^ch^ is all the Stranger, becaus Cartesius was author
of the Invention, that Motion had law's. And that

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[197] i.e., '(greatest) friend of truth'.

[198] i.e., 'sets down indices in his book'[?].

[199] i.e., 'temperately and reclined'.

6. principles.

Philosofy might be [conduceted?], more Mathematico, &
with as clear light, as Geometry; w^ch^ are y^e^ Model[s?] of
all this Author's works, that he put's forward as his
owne, and In ~~that~~ /so doing is Not\ y^e^ onely Cartesian plagiary. But, as
I was Saying, however comon or Cartesian these rea=
soning's are, I know My owne thought's, where they are
sincere & pure, as I Repy^r^sent them, ~~want~~ without aim or
designe, but Either displaying a fair understanding,
or by open Errors, provoke some Corrective pen, to
Chastise them, ~~& So~~ /whereby I may\ obtein a better Information. And
I must, tho I am ashamed to say, I know No profes=
sion, In y^e^ way of arts or learning so Incumbred With
y^e^ vices of y^e^ Mind, Nay want of Comon honesty, as Naturall
philosofy is /so\ that In My Judgm^t^, sincerity with Modesty
may Compensate a world of failings. Then I proceed.

There being Nothing ~~by~~ without us but body, In a State of
Chang, or Motion to be relyed on as a principle of Naturall
knowledg; And y^e^ World appearing to us, to have So Much
of variety besides, wee must look for principles of all
the rest somewhere Els, that is In our Modes of perception,
w^ch^ is a subject that treat's of humane Capacity, I Shall
Referr y^e^ Most part to a Just discours, as I Intend, of that,
And Suppose here onely, that all Seeming Qualitys and
property's of body, as colour, tast, sound, blunt, Sharp
hot, cold, wett, drye, & y^e^ like to be but fantosmes in
our Imagination & Not In the things, w^ch^ are the occa=
sion of them. And have onely to seek out In these
narrow

Narrow straits of Body's and their movemᵗˢ, for varietys
wᶜʰ possibly /be\ (I am Not positive yᵗ all are) the Causes
of them; As by yᵉ sequell may appear;

But In yᵉ Mean time under this head, I ~~must~~ Must
take Some Notice of Some other thing's, wᶜʰ have bin, &
yet by many are accounted principles. As for yᵉ old Aristo=
telian Elements, as also the -salino-aerio,-Sulfureo-
chimicall principles of Dʳ Mayo, and of yᵉ Rest of
pyrotecknian's, wᶜʰ they Reduce under the titles of Salt
sulfur & . . . . .[200] They are all Sufficiently Exploded
by Mʳ Boyle, who Experimentally hath demonstrated
those Not Elementary body's, becaus all other sub=
stances, & one out of yᵉ other are by distillations Ex=
tracted, as who Will may see in his works. And yᵉ Noble
Mʳ Boyle hath also by his Industry & sagacity demon=
strated, that Nothing is so usefull In philosofy as
Elabourate Experiments, and Chiefly by beating Men
out of fantastick Imaginary principles. ffor It is
In yᵉ Nature of Man, who allwais thinck's himself
a philosofer, to be pʳcipitate in Enterteining prin=
ciples, and then No less pertinacious In holding to
them, never to be removed by reason or authority
And onely Experimentary demonstration Can doe it.

The Moderne's have taken Empty space for a princi=
ple, calling it Vacuum, opposed to yᵉ Cartesian plenum,
this is like yᵉ Aristotelian privation, wᶜʰ is a very
odd

[200] RN makes several disparaging references to John Mayow in his MSS. See BM Add MS 32526, 100r, n. 96. RN leaves a space underlined by dots here - it is not clear whether he is intending to return and fill in the space, or inscribing a gesture of depairing contempt.

8. principles

odd Matteriall to make a principle of, and is as Much
as to say Nothing Engenders something. but this being
a larg and Important Subject I have Resigned to a
place apart under ye title plenitude.[201]

The late author of ye principia,[202] seem's to decline all
phisicall principles, and assumes certein powers
ffor geometricall Ends onely; as centripetall, centrəi=
fugall, attractive, aversive, Inertiall, and ye like. And
It had bin as well if he had made No phisicall Conclu=
sion's; for In process from these prcarious principles, he
falls directly upon ye vortexes, of Cartesius, theres' his
biais. wch is a strong proceeding; one would have expec=
ted, the scaffolding at least on a phisicall bottom, for
the hacking downe such a structure as that. but perhaps
ye Author had, or hoped, ye Reader would, having brush't
thro such a wilderness of demonstration, forgett, that
the very principles, as phisicall were disclaimed.

In a latter book[203] ye author proposeth a Method, he Calls
analitick, rather then synthetick, for proceeding In
naturall philosofy. If he mean's thus, that wee are to
Argue from facts, sensation's, or Experiment's to principles
and Not E contra, from principles to phenomena, wee
must agree with him. ffor what light have Wee, for
discovery of principles, real from Imaginary but proofs
and tryalls; that is Experiment? but he means far=
ther, or I mistake him, and that is, that wee are to
collect constant Effects, and then denominate
powers

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[201] See below, 210r-219v.

[202] Unless this text dates from after 1727, RN's use of the term 'late' must mean recent rather than dead.

[203] Newton's *Opticks*, published in English in 1704 and Latin in 1706; RN is referring to Query 23 of this edition (which became Query 31 in the second English edition of 1717).

powers from thence, & take those for principles. ffor
say's he, what wee constantly find happen's, wee May
build upon, true; but then It must be distinguisht, if
It belong to our Imagination, and opinion, or to y^e^
objects afore us. ffor In objects wee find Nothing per=
manent, but place-filling. but It is as Constant, to be
observed, that y^e^ Sun is light, & shines, that all bodys
seem Coloured; wee must Not therefore ascribe y^e^
light to y^e^ sun, or colour to body's, but to our fan=
tasia, and y^e^ Caus of it onely to y^e^ Sun, & those bodyes,
so wee are there hitcht off our principles. So admitting
Refraction shews y^e^ Rainbow-colours, (w^ch^ is Not true In
all cases) to argue from thence, that Ray's are In their
nature Induced with that w^ch^ makes in our sence, y^e^
Image of Colours, Red, blew &c. /and accordingly have different Refrangibility\ and in
comon light
are blended, but In Refraction Separate, & so are
displayed In order according to y^e^ proper angles of
Refrangibility. This is Error /In principle\ ffor it is as Easily denyd
and, It may be sayd, mixture, as well as separation /may produce colours\, of
w^ch^ In proper place. So The Cours of y^e^ planet's, say's he, is to
move In Ellipses, with y^e^ Sun In umbilico, and tend to
move In strait lines, but are deteined by the at=
traction of their center, and would be more circula=
tory, but that they act by drawing one & other
aside, Into Ellipses. therefore there is a force of attrac=
tion in all body's, according to Quantity, whereby
they

they tend, according to ye Magnitude of Each, mutually
to come together. so ye moon by attracting or lifting up
ye Sea, wch ye Center of ye Earth attracts downewards, &
makes ye tides. And ye anomala of ye Moone, is from
ye unaccountable attraction's of ye planets passing by
In ye Monthly Revolution. And consequently body's
must all Gravitate by attraction towards ye Centre of
the Earth. And Attraction Is made an Instrument
called a principle In philosofy of attraction, to Remove
all weighty doubdts. I had rather he had sayd directly
an occult Quality; ffor If I ask how, attraction? the
Ansr must be that. what is this but Relapsing back
Into the dreggs of ye peripatick philosofy? His argument
for this is In his opticks, where he say's that to take
constant Effect's for principles, is an analitick procee=
ding, and most scientificall. ~~And~~ /but\ grant /that\ all bodys in
ye world moved as If they did attract one and other
It doth Not follow that /It\ is ~~by~~ /from\ an/y\ Intrinsick principle of
attraction, but /may as Well be\ by Impulsion, (as ye truth will appear to
be.) and therefore the true analitick is not to make
a principle of an abstract, as attraction is, of whose
Essence Non Constat.[204] but so use the fact, and argue What
necessarily follows from that, and so by Conformity With
other appearances, become argumentative, to Confirme
ye use of some power's, wee know must Exist; and then
Inferr it is Most probable, those powers also caus these
Effects. as to Instance, bodys must upon occurs alter the
cours

[204] i.e., 'it does not appear'.

cours of the Movem'ᵗ. this wee know follows Necessa=
rily, from yᵉ Nature of body, that admitts not penetra=
tion, & is all Resistance. And If by any generall or Com=
mon Effect's, wee can apply this principle, It is well,
but Not to forme one wee doe Not know. Such as
Attraction, and all Quallity's vulgarly ascribed to
body Except onely tenacity of place.

For a principle should be demonstrable, or at least
not capable of being Confuted by Experiment, as
this of attraction may be, & will, as also that of Re=
fraction, as to Colours. So vaine is it to Collect prin=
ciples, otherwise unknowne, from Certein /collection of\ Effect's, Wᶜʰ
can Never be argued universall, & If they were so,
yᵉ analitick consequence is Not true. but /lett that pass yᵉ text is\ yᵉ Strangest
principle of all ~~is~~ that /wᶜʰ\ he Calls vis Inertia. wᶜʰ says
he, is a most significative Expression; of what? Not
of a principle, but It is a description of certein effects,
upon collision of body's. It is a thought of Cartesius
that body's at rest, demand yᵉ Same force to /be\ Moved
as others in Motion to be Stayed. This is from a Na=
turall axiom, drawne from universall Experience,
that all thing's that alter, are caused /or\ forced to it,
and that Nothing doth it self. for Ex Nihilo Nihil fit.[205]
But the ascribing active force to dullness, Was Not in
yᵉ Mind of Cartesius, and it is onely a New expres=
sion, & somewhat specious, & therefore is a favorite.
And however blind it is as to all reason and prin=
ciple, yet I must Grant, & In place shew, that it
describes

[205] i.e., 'nothing comes from nothing'.

describes, the very Events of ~~Implu~~ Impulses, but Makes
none understood, w^{ch} may be sufficient for a Geo=
meter, but must not claime a post in philosofy.
The Same thing Introduced from a true principle, Will
do y^{e} Same service, as he apply's it, but then, as will
appear, It is by consequence & Not as a principle.

One thing More to be observed of this Method, of Ma=
king principles, of Seeming powers, & giving them
names, & then working back into Nature, taking really
nothing from thence. such are attraction, separation,
and the centranean powers. It is that they are hy=
potheses, and Not principles, becaus y^{e} Substance
of them is demanded, and not proved or allowed.
Hypotheses are built on principles, but Not principles
on them. Therefore, these power's Should have bin
Interpreted, or Explained, so as y^{e} source or founda=
tion of them had bin under Stood, then as Hypotheses
It were reasonable to have proceeded with them, as in
other Cases. Therefore the title of y^{e} book Is fallacious
[marg][206] vis^{t}. Naturalis philosofia^{e} principia Mathematica.
ffor he disownes the principles as phisicall, then how
can they be principia Naturalis philosofia. they
may be data, for y^{e} use of geometry but Not
principia, therefor In My apprehension y^{e} author
is a Great leader, In geometry, & In phisicks No less
a misleader, and It may be demonstrated the
Geometer hath seduced & Corrupted y^{e} philosofer.

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[206] marg: '*q*^{u}'

principles. ~~13~~.

I doe not p^r^tend that wee know all the principles
from whence may be Resolved all naturall effects, for
Much of y^e^ apparance depends on animall life &
sence, w^ch^ is less understood, then matter's abroad. It
is Enough If wee know and are secure of some. Now
There are Egregious effect's, of w^ch^ I never could be
satisfyed Critically of their principle. as. 1. semi=
nality. 2. vegetation. Wee doe Not know that any
plant's are produced Spontaneously, No More then
Animalls; but all by propagation, Either from a
part of y^e^ plant, or a seed. but as to that wee have
this acc^o^, that a seed is but a budd of y^e^ plant, Repo=
sited In a proper nutriment, to Supply y^e^ first Growing,
till it can shift In y^e^ soyl at larg; So It Returnes
that y^e^ Continuation of plant's is by perpetuall
propagation /of\ ~~by~~ its parts transplanted; but there
cannot be a new plant made, however by In=
sertion's Strang alteration's are made of them.
And I know Not any filtration, aeriall pressure, accor=
ding to Malpighius,[207] with his valves, or other Na=
turall Experiment, will Shew Satisfactorily, the
manner of vegetation. Nor is it In y^e^ power of
art to make any vegetable, or seed, the most
contemprible moss that is, is above the boasts
of chimist's, & triumph'd more over them, then their
Antimony triumph's as Basil valentine[208] p^r^tends, In
medecine. And so wretched is y^e^ p^r^tence of Making
what

[207] Marcello Malpighi, 1628-94, physician, comparative anatomist, and early microscopist who worked for much of his life in Bologna. He was famed not only for the astuteness of his observation and interpretation, but also for the precision and clarity of his drawings. He was a a member of the Royal Society in London from 1669.

[208] Basilius Valentius, believed to have been an alchemist in Erfurt in the fifteenth century, and to have been the author of numerous works on chemistry/alchemy in German and Latin. It now seems likely that he never existed. It has been suggested that he was the invention of Johann Thölde (*c.* 1565-1624, the publisher of the earliest known volumes) and others. RN seems to be referring to *Triumph Wagen Antinomii* (*The Triumphal Chariot of Antimony*), first published in German at Leipzig in 1604, and in French and in Latin in 1646.

14. principles

What men Most covet gold, they Cannot Make y^e^
very ordure of a beast, nor the least thing that is
of ordinary Naturall proceeding. Therefore here wee
are to seek for a principle. And for Necessity use the
termes of Growing or vegetation, with y^e^ Names of
y^e^ Individualls, as language to Express what Wee
mean, without other understanding, then of the
thing's themselves produced, as Nature Shews them.
And herein Cartesius, I thinck, was too aspiring, In p^r^=
tending, out of his principles to Resolve all Naturall
process whatsoever, w^ch^ Made him Strain Into an ab=
surdity, by ~~auato~~ automatising Brutes, and Indan=
gering the very Essence of human soul. So fatall is
p^r^sumption, In such Cases.

Another thing is Most difficult, If Not Impossible
to be understood, and that is, animall generation.
And altho the late discoverer's have shewn the ana=
logy of Egg's, ~~to~~ /with\ seeds of plant's, and y^t^ all creatures are
eviparous; yet the process of Increas, from y^e^ punctum sa=
liens,[209] as well as y^e^ Incoation of even that, to an orderly
formation or rather structure of the members, & parts
of Every animall, is and I fear Ever will be a Mistery.
the rather, becaus, w^t^ever to y^e^ Contrary is p^r^tended,
with y^e^ old blind story's, of Egiptian slime, & half
formed animalls In it, (or rather half drowned) there
is No such thing, as a new animall in y^e^ world, but
all that appear to us are produced by generation
w^ch^ is Not Equivocall in any thing. And the Con=
currence

[209] i.e., 'salient point' - presumably implying the immediate product of the very moment of (sexual) generation.

currence of male & female necessary to y^e^ production
of them, Some species are very Strang, as what Should
limit variety. peper water In may produceth Infinite
animunculi; wee cannot say it is Equivocall, being
so small as not to be examined, and No Examinable
cases are so, w^ch^ argues those should, tho wee know 'em
not, be as all other's wee doe know /are\. Then other Species
some thinck ~~are~~ Include both male & female, and act
on Each other at y^e^ Same time alternately, as Snails
w^ch^ particulars are y^e^ Subject of Naturall history, but
tend litle to Explanation of the mistery, so that must also
be ~~fe~~ let alone, as wanting just principle whereupon
to found a Resolution.

I know many, and the thrice most worthy D^r^. Barrow
In his discours of the failing of y^e^ Cartesian Hypothe=
sis,[210] Instances In these matters, and Inlargeth upon
y^e^ subject of Anima Mundi, where he with others
as I sayd have a sort of faith, that there is somewhat
more then Mechanick in vegetation; And they have
an opinion that a sort of soul, or Sprituous prin=
ciple Reignes In all plants, &c. but More visibly
In animalls, as Brutes; And to this, I cannot say
other but that I ~~deny~~ am Ignorant In y^e^ Matter,
I cannot owne principles I know Nothing off, Nor
have any mean's to Examine. If folks will beleev
such extraordinary principles, I am Content & /Inclined to\ Joyne
with them; but this Must be faith, & Not philosofy.
That will not honestly walk out of its knowledg.

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[210] Isaac Barrow, 1630-77 (see note on f. 46r, above.) RN refers here to Barrow's critique of Descartes (for his materialism) in his 1652 MA oration - *In comitiis*, 1652, *Cartesiana hypothesis de materia et mote haud satisfacit praecipuis naturae phaenomenis* (*The Theological Works of Isaac Barrow, D.D., Master of Trinity College, Cambridge. In Nine volumes. …* ed. The Rev Alexander Napier, M.A., Cambridge University Press, 1859, xi, 79-104). Barrow had also reflected, to some degree critically, upon Descartes' notion of space in Lecture X of his *Lectiones Mathematicae xxiii; In quibus Principia Matheseôs generalia exponuntur: Habitae Cantabrigiae A.D. 1664, 1665, 1666. etc,* London, 1684, (in English: Barrow, I., *The Usefulness of Mathematical Learning explained and demonstrated: Being Mathematical Lectures Read in the Public Schools at the University of Cambridge. etc.. Translated by the Revd. Mr. John Kirkby of Egremond in Cumberland*, London, Stephen Austen, 1734). The term *'anima mundi'* (i.e. 'world soul') was also used by Newton and the Newtonians, it re-'animated' the materialist universes described by the mid-century natural philosphers (i.e., Hobbes and Descartes), RN describes their use of the term well here.

16. principles

I cannot but take notice of one method, w^ch^ Cartesius
and other's after him takes, In the theory of Motion
w^ch^ is Not so much faulty In the thing, as unphilo=
soficall in y^e^ Manner. and that is the subjecting Mo=
tion to severall laws, and those law's they pass as prin=
ciples. This I say is unphilosoficall, for they May as well
make Every phenomenon In nature y^e^ Consequence of an
Immediate law, as any one Effect of corporall Impulls.
Therefore I know but one law to w^ch^ Matter is Subject
and that is Impenetrable Extension, w^ch^ will be obeyed
whatever happen's. As for the Continuing of things in
their state, It is Included In y^e^ Notion of body, as Not
having life or automatall principle. All the Rest of
The conclusion's In this hypothesis, are either Necessary
Effect's, or such as may be consequent to Necessary Ef=
fects, so ~~y~~ y^e^ /wee\ demand Nothing but that body is Extended
And Impenetrable. and waive all other laws & Max=
imes whatever.

160r[211]

principles. 1.

It is shewed partly already that the principles of Na=
tural philosofy, are drawne from two stocks, one is
Humane faculty's and manner of perceiving thing's, and
y^e^ other is from y^e^ essence of things themselves their Modes
and changes. So much as moves from sence consists in this.
The Body is a frame composed of divers members, w^ch^
have capacity of being moved, more or less, without
being destroyed; but Receiving Impression's from Exter=
nall force, are yet y^e^ same, capable of y^e^ like Conti=
nually, so long as life lasts. These member's or part's
of the body are all, by certein ductuses or Nerves, con=
centered in some Comon part, (supposed In the brain) /so\
that none of them can be moved, but the action will
continue to that part ~~of~~ /w^ch^ is y^e^\ Resort /[...?]\ called the comune
sensorium;[212] and In that place the sensitive being Re=
sides, and Receiv Notice of all these action's that affect
y^e^ severall member's or parts of y^e^ body, w^ch^ is sensation.

Some parts of y^e^ body are more susceptible of Motion
from without, and destroyed with less violence, then others;
and those are Called organs of sence. as y^e^ timpanum
of y^e^ Ear, the tubes of y^e^ Nostrills, The tongue & pallat,
and y^e^ Retina, or bottom part of y^e^ Eye; The Rest of y^e^
human body is not so signalised, but the small Im=
pression's upon it from Exterior action's have one deno=
mination, & that is touch. But y^e^ organ's are from
their particular tenderness, distinguished; and ac=
cordingly

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[211] This next section (to 161v), which is clearly later than the preceeding one, is written on very slightly smaller paper (height is 2-3mm less), in a slightly finer pen.

[212] The imagined location in the brain where all sensory apprehensions would be brought together and (in many schema, including that of Descartes) be submitted to reason or judgment. This is the process which RN goes on to describe below. *Sensorium commune*, as it was usually written, is therefore the latin source of one now obsolete (although very useful) meaning for the term 'common sense', sometimes called the sixth sense (the sense of sense).

dingly denominated, as hearing, Smelling, tasting &
seeing; It is first to be Noted In generall that a Mo=
vement of Every Exterior part of the body, is a Caus
of sensation, and the variety of things occasion's, that
No two sensation's are alike, and accordingly the touch
at ye foot, is not ye same as a touch upon ye hip or
shoulder, and so of every, & the minutest part of ye body.
by wch difference In ye Manner of the touch, the Mind
from very Early Experience, learnes to distinguish between
ye foot, hip, & shoulder, &ce. from ye specifick mode of ye
sensation, and Not otherwise; ffor If a member be
cutt off, and by mean's of ye conduct-nerves, ye Same
mode of sensation arives, as it will at the sensorium,
the mind hath a sence /as\ of that even absent Member.
but I Inlarg Not here of this, and Conclude obser=
ving that touch upon ye organ's, is so peculiarly
different from ye Rest, Either from ye tenderness of the
part, or some neerer concerne it is to ye Mind, that ye
sensation's from them, are so Equisite & unlike the
Rest, they have Names apart. as all touch upon ye
timpanum is sound, & what they call a Ringing
In the Ear. And all touch upon ye tender Retina
of ye Eye, is sight, light, or Colour; and this is Not
onely from ye proper object wee call light, or colour,
but any Gros contusion with a fist, or putting a fin=
ger In at a corner of ye Eye, all Impress a sence of
light, becaus the Impression reacheth ye Retina
from whence Every Sensation is called light.

principles. 3.

Now as to the Images that y^e^ Mind Conceivs upon Each
of those sensation's, that is such as wee know proceeds
from a stroke upon a bell, & wee Call Ringing, and
others that Moves[213] from y^e^ Sun, well call light, with
y^e^ Subdistinction's of Blew, Red, yellow, & ~~sn~~ /so from\ other sen=
sations with Infinite variety, the Naturalist can Make
no account of them but as Essences, w^ch^ doe on Such
occasion Exist in y^e^ Mind, and thats all. ffor If one
asks why the Impression that shew's Red should Not
Shew as well blew; or why sound should not be as light
or this manner of sound, as another, it is the same as
to ask, why is this Island & that Continent, here sea
& there land. Cartesius answers It was y^e^ Will of God
It should be so, w^ch^ is y^e^ true ans^r^ is to be given ffor the
Existence of things. But yet it is possible the Naturalist
May find out, what difference there is in y^e^ action's y^t^
caus different sensation's, as In the case of Musick is
done Most Exactly. ffor an octave is found to be
pulses swifter as. 2. to. 1. and fifths as 3. to 2. and
It is Not despaired of but y^e^ like may be found as to
Colours, but for Comon touch wee are aided More In
Examining y^e^ object; ffor wee know what it is Makes
the Sence of soft, hard, rough, Smoth, clammy and
y^e^ like. And if wee had not these helps of Eyes & Ear's
with the varying y^e^ posture of feeling, but lay fixt, and
Received Impression's on o^r^ body, as wee doe on y^e^ organ's,
there Might Emerge in our sensation such specifications
of

[213] The 's' is here scratched out.

of Meer touch, as Would be analagous, or have forme
as sounds & colours have. So In this place we goe No
farther then to be assured, that all the Images in
the mind occasioned by sensation, are essences re=
siding there; and the sensation is onely a Movem'^{t}
of some part of y^{e} body, where of y^{e} variety's ~~Mall~~ /are the\
caus of our distinguishing the parts touched, and
/(thro experience) of distinguishing\ y^{e} object also. so this being dispatcht, wee
have done
with ~~that part of~~ /the principles of\ Naturall philosofy as depend on
humane capacity. and the modes of sensation.

1. the next stock from whence wee draw all other
principles of naturall knowledg, is the mass of ex=
ternall thing's in the world, abstracting all sensi=
tive creatur's, and considered as if None Such as are
In y^{e} World. And those must be the same, as wee sayd
had Existence, for w^{ch} no caus could be given, or other
discours had of their being, but onely the bare affir=
mative, that they doe Exist. Then setting aside all
that was sayd to belong to sence onely, w^{ch} In vulgar
disours (but untruly) is attributed to Externall objects,
as colour, tast, hard soft, cold, hott, & y^{e} like, wee
can find no mean's to know there is any thing in
y^{e} world, but by the resistance wee find one body is
to the movement of another. and so by universall
Consent, founded upon universall proof, It is Concluded
that body fills place, and is uncapable of being pe=
netrated by any other. and this by an abstract terme
and very properly Is called Impenetrability. And that

And doth not Concerne himself, with y^e^ Efficient Caus;
That is would seem to say something, but In truth say
nothing, or wors ~~when~~ /as\ it seem's somewhat, & is No=
thing. ffor when he say's two body's come together
by attraction, what is it but to say they Come toge=
ther by coming together, unless he will explaine how y^t^
attraction is; that is, shew y^e^ Efficient caus. I might give
here farther Examples of like darkness, as vires centri=
peta^e^ , centrifuga^e^, se mutuo attractientes, fugientes, & the
like. but one onely ans^d^, as that of attraction answers all.

But while he Supposeth, as he Insinuates, that all body/s\
~~Is~~ /are\ Indued with a vertue of attracting Each other, ad
mensuram densitatis,[215] he proposeth a plaine principle
If he Could prove it. And it is of y^e^ Same forme with A=
ristotles Quality's; and he seem's to follow him, for ~~as~~
he produ~~ceth~~/cing\ attraction of Gravity, y^e^ Magnet, & Electri-
calls, [~~..~~?]/he\ Say's ~~he~~ /farther\ there may be other attraction's Not so
discernable, by w^ch^ the Continuity of body's and divers
other pha^e^nomena may be ~~maintained~~ /Resolved\. Now In gene=
rall /as\ to all Quality's and property's /I say\ What are possible
and Not, Is Not the Question, but what /really\ are? and by that
Gage wee have None wch wee owne distinctly & clearly
annext to body but that of Impenetrability. And to ad=
mitt principles, (w^ch^ are like Rudder's In a voyage,) of w^ch^
there is No clear evidence, is to condemne y^e^ voyage be=
fore it is undertaken. And No apt-ness, or ~~other~~ defect
of solution /otherwise\ will be Sufficient to set up a principle, of
w^ch^ there is Not a specifick & certein Evidence; of w^ch^ More
will be sayd when I treat of Hypotheses.

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[214] The paper is very slightly taller (see footnote above, on f. 160r). The sheet is marked on the top RH corner, which part also seems to have been folded back and rubbed, and is darkened, apparently owing to dust. Folding also at the foot of the page, with further dark marks. If this is a continuation of the essay on the previous pages, as seems most likely, then according to RN's numbering, two pages are missing.

[215] i.e., 'in proportion to their density'.

10. principles.

Some have Introduced principles of various kinds; Some
whereof may concerne simple body's, other's aggre=
gates. as to the latter I cannot allow any, ffor What
is Not in simple body's cannot be In a Collection
of them; ffor It is onely Multiplication & Not Creation
that Result's from adding & compounding. And as to
Simple body's wee have to Consider, Springyness or
Elasticity /&\ Continuity, ~~ple~~ and of compounds fluidity
Rarefaction & condensation, most of w^{ch} are so con=
siderable, ~~as~~ to diserve discourses apart.

As to y^{e} old atomists who Imagined y^{e} Matter of y^{e} World
devided into parts Indevisible, have bin so farr follow=
ed, that Except, mentally, but as to actuall devision
y^{e} part's of matter are [accounted?] Indicerpable. But
when they come to their p^{r}cipitate Cours In vacuo
Infinito,. wee leav them; Nor is there any Need to En=
ter upon Repetition, of comon discourses, have bin on
that Subject.

But while wee discours of principles, one would thinck
all reasoning of that sort, should be undermined, by
y^{e} late book, Intituled, Naturalis philosofia^{e} principia
mathematica. And If y^{e} p^{r}tension of that title were
made good, the Royall Society ought to Erect a sta=
tue In hon^{r} of y^{e} author. but I fear y^{e} termes are Mista=
ken, ffor the principles of Geometry as taken from phi=
sicks, ffor they shew the materiall, & y^{e} Geometers
weigh & measure it, and wee thanck them for their
paines, becaus in many thing's y^{e} Naturalists profit /greatly\ by them.

163r

Hypotheses.

~~An hy~~ Every Supposition is an Hypothesis, but In the lan=
guage of phisicks It means A few supposition's applyed to
Resolve many, If not all y^e phenomena In nature. and in
this age Nothing is more Cryed out upon the Hypotheses, as
y^e Greatest Impediments of science. Whereupon the humour
of Rejecting all Hypotheses, and Relying upon Experiments
onely Came in; Our Royall Society is founded on y^e Modell,
whose Motto is, Nullius in verba; and they p^rtend to Col=
lect Experiments Enow to suggest an Intire hypothesis of Na=
ture, and untill that good harvest is Ripe, they will Subsist
without any Science at all. This I account an Extream the
other way, ffor /one May securely wager,\ Such a Collection of Experiments, ~~as one may~~
~~Securely Guess~~ will Never be made; and to Say truth wee are
not capable of being acquainted Enough Either with great
magnitudes, or deep Exilitys /To hope for a [perpect?] Information of Nature\ and what
wee know, or (to
Speak in Compass) guess Concerning ~~them~~ /those Reconditi\; must be founded
on a Conformity with y^e Event's of thing's, wee doe Cer=
teinely know; and that is Hypothesis. To say truth Nature it
self is uniforme and aggreable to method in all things, &
causes apparently run together Into Some Comon princi=
ples; wherefore truth in Naturall philosofy neither is, Nor
Ever will be out of Hypothesis; And this is Confirmed by
the most antehypotheticall men, & None More then the
Author of y^e principia. and Since ptolomy's orbs, there
hath Not bin so Rank an hypothesis as he hath made /of y^e heavens\
on y^e Subject of attraction; And this is so violently strained
the poor distressed vagrant Comets are brought into pe=
riodicall elliptick revolution's, without any Certein Evidence.

163v

2. principles

To compose an hypothetick unity. This had Never
bin as I dare say, If the spirit of Contradiction against
Cartesius had Not raigned.

Since Hypotheses In philosofy Must, & will be Enterteined,
It is reasonable to Inquire how to secure the best. And as
to that, y^e^ onely rule is, with y^e^ Experimentists, to find
& Not make an Hypothesis, That is, gather all the Cer=
teinty's wee can, as was before discourst of principles,
and holding those fast, see ~~wah~~ what changes they are
Capable of, and what must Necessarily be Consequent
of such changes; and then we Gaine so Much Ground
In the generall, whereon we may Rest. Of this sort I
take the rules of Motion to be /And\ Then the Most Recondite
phenomena w^ch^ by y^e^ suit of those sure p^r^misses may be
shewed possibly to be Resolved, the extent and Nume=
rosity of those possibility's will argue considerably
a probability. As for Instance, If all the knowne &
visible effects of palpable thing's in y^e^ World be
plainely consequent of Body being Impenetrable
and moved, producing changes on all sides by
mutuall collision's. and It can be shewed that heat
light, sound. &c. /y^e^ Imediate causes of ~~w^ch^~\ w^ch^ lye hidd in Inscrutable Exility,
may be solved under y^e^ Same principles, It is Not
a litle probable they are really so ~~solvable~~ Constitu=
ted. And If there be /such secret\ pha^e^Nomena w^ch^ will Not agree
with those principle's, It is needfull to rest Suspended
and owne an Ignorance of them, till some farther
discovery's are made to Give an Insight Into them
so. fuga vacui?[216]

[216] The writing at the bottom of the page is very crowded, and these last three words are written in a tiny script - perhaps added at the same time the phrase was used on the following page.

Hypotheses 3.

And wee are Not to despaire of such discovery's, as as wee
Need to p^r^cipitate opinions, without great clearness, ~~let~~
ffor the case of y^e^ air teacheth the contrary; It is well
knowne the condition of our air, untill the torricelli=
an Experiment, and In suit of that, the air-pump
& baroscope, was No less unknowne to us, then to y^e^
Inhabitants of Saturne, if any such be. But those Ex=
periment's have disclosed that profound Mistery of
fuga vacui,[217] and shewed us an Hypothesis of y^e^ air, by
w^ch^ most phenomena in it are clearly, and satisfac=
torily Resolved; ffor w^ch^ reason's I conclude the safest
path in y^e^ way Hypotheticall, is to be sure of y^e^ principles,
and upon them to walk no farther then y^e^ clear light
guides; and rather then Enter Into mist's, rest Contented
Expecting such may clear up.

But If I may conjecture what ~~made the~~ hath ledd to
such an erroneous use of hypotheses, as hath so discredi=
ted them; It seems thus. Some have thought an hypothesis
that hitts all points and solves all the phenomena /is to be Enterteined\ and
such as comes short of any to be Rejected. And the disputing
humour w^ch^ for some ages Infested knowledg, Styled, of
the scools, augmented this fondness; ffor they ffeared
nothing Equall to a Non plus[218] in dispute, and If by Cap=
tion and asseveration they could wrangle it thro, they
never found fault with their principles; and the Cri=
terium between Good & bad Hypotheses, was No other
but it will, & it will Not Solve y^e^ pha^e^nomena. this
appeared in y^e^ Case of the ptolomaick orbs & Epicicles;
ffor If y^e^ moderne vertuosi, had Not shewed by y^e^
phases

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[217] i.e., 'flee the vacuum', i.e., that in nature the vacuum will always be filled - i.e., that 'nature abhors a vacuum'.

[218] i.e., 'no more'; i.e., that nothing could be added, that it was complete.

phases of venus, w^ch that Could Not solve, that it was
fals, the Acadamy's had Reteined it to this day, and very
unwillingly they parted with it as they did.

The 2. Hypotheses that Now are sur la tapis with y^e
vertuosi, for p^reminence are the Mechanick or Cor=
puscular, and If I may So Call it, the Attractive, the
fformer lean's on y^e main principles, & Method of Car=
tesius; and hath y^e Suffrage of the vertuosi Immedi=
atey Succeeding him. And particularly M^r Boyle hath
Gone a great way, by his Experiments, to demonstration
the ~~main~~ /reasonableness\ of it. And this is that Hypothesis or rather
method or Model, I work upon. aiming to distin=
guish /of\ principles /the\ sure from /the\ frail, and to move to Con=
sequent's, ffirst In plain cases, by Indubitable Necessity,
and in other's less plaine by Conformity; and In those
I comprehend Not, to Rest suspended. But As to the
Hypothesis ~~(as I must Call it)~~ of attraction, ~~Supposed~~
Inspired to matter, ~~so that~~ /whereby\ Every thing draws Every thing
by unknowne, ~~I might Say~~ /or ~~rather~~\ Incorporeal Mean's, I have
onely to say, Negatur.*[219] And this is the acc^o so ffarr as I Shall
be troubled to give any Hypotheses.

To conclude this subject, It is to be Noted that aptitude
of an Hypothesis is no argument of its truth, and Next
No ones hypothsis is y^e Stronger, by shewing weakness in
others. but If wee observe author's, particularly him of
attraction, wee Shall find frequent Notes, that this & that
were never het Resolved by any, as If the ffitting things
that sat not so well on others made 'em his owne. there=
fore It is Not ~~Inventing~~ /making\, but finding, that furnisheth an
Hypothesis; * _ _ _ _ .

---

[219] 'Negatur' means 'denied'. It seems likely that the asterisk indicates a footnote, referring us to the dashed line following an asterisk at the bottom of the page. The essay is here cut short, even though it is drawn/drawing to a conclusion there are likely to be pages missing. And there are pages missing from the beginning of the next section too, where we 'begin' at page 73 of a similarly titled (if not identical) essay.

Other Notions /of things\ y^t^ Subsist In Compa= rison onely, very hard, to be Rightly considered. vis^t^.

Magnitude
Space
Motion
time.

There are Some other Notions /fall under this title\ w^ch^ I Shall take into debate, becaus I thinck a right Judgm'^t^ of them Conduceth Much to y^e^ accomplishm^t^ of philosofy, and ~~y^t^ is~~ /they are\ so Much harder to Come at as our p^r^judices, Concerning them are Strong, ffor they are dated Even with life it self, and ordinarily are coevall with it, litle happening In y^e^ whole cours, to create y^e^ least doubdt or Scruple concerning them, Nor Can they be abstracted, without y^e^ Greatest violence of thin= king, so much as Even y^e^ strongest & clearest thinkers In other matter's, have bin hurryed away by them. These are Comonly knowne by y^e^ termes of Magnitude, Space, Motion and time. but fall all very near Into a coinci= dence, In the more generall terme Extension on w^ch^ all depend; but yet to Comply with language, I Shall discours of them a part.

of Magnitude., And how our In= [f?]irmity's give I= deas of demension or rather Carac= ters, w^ch^ are not [I?]n nature but In [fa?]ncy onely.

1. As to Magnitude, wee have Notion's of Immensity, and Exility. and these goe /not onely\ to all sensible Idea's, whither of space or ge= nerall Extension, & body In all its demensions but /also\ to Motion and time, w^ch^ as to Measure are y^e^ Same thing, and ~~those also~~ Referr to dimensions of body & space as will be shewed. these notion's [wch?] are besides the matter, are truely of nothing but our owne[221]

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[220] Many of the remaining folios in this volume use a wide LH margin. The wide LH margin seems to be a signature form of RNs later writing. Fols 80-91v (above), also later pieces of writing, used this format.

[221] This page was cut unevenly at the bottom. It has since been restored by conservators. See further comment in note overleaf.

All magnitudes
In same proportions
alike, but p[r]judice
doth Not bear
thinking Indiffe=
rently of them.

Strength to sustein, and capacity to know.
ffor wee are apt to ascribe somewhat In y[e]
composition of Great thing's, that did Not be[=?]
long to small. As when I say the courses
of y[e] planetts about y[e] sun have No more
naturall Excellence then straws In a whirl
pool; It raiseth a Sort of passion, so that
from arguing folks grow angry, as at a
fals & profane speech; all w[ch] is a litleness
of mind, that doth not readily find /out?\, that
all body's ~~g~~Great & Small are governed by
y[e] Same rules. So wee can scarce hold ou[r?]
admiration back when wee conceiv such
Imensity's, to w[ch], y[e] /stupendious\ systeme of y[e] sun /
&c.\, is
but one of a Numberless Number of the
like, of w[ch] wee have Intimation from y[e]
scintillation's of y[e] fixt starr's; and that all
proportion's conteined in it may be found
with Homer's Iilliadds, In a Nutshell. one thing
that conduceth this Idolising Immensity
of body & space,[222] is that great thing's put
us to pain, & torture, becaus our body's are
not of a composition to resist them, /&\ ~~but they~~
are apt to destroy us; hence wee have a
sort of ffear of thing's greater, as also a
contempt of things less then o[r] Selves. It is
a pain to travell a few miles, so wee thinck
y[e] Way long; and ~~from~~ /according to\ these passive
Imagi[=]
nations, wee carry on the proportion, to Immen=
sity, as I have shewed, w[ch] Must[223]
make

[222] *See* note on f. 109r.

[223] This shorter line is the result of RN 'writing around' the uneven cut at the foot of this page.

make us have, a Stupor in thought, where as In Comon thincking wee Compare o^{r}Selves with y^{e} whole world, as It is In a geometrick way set forth by astronomers. on y^{e} other side In y^{e} Idea of exility, wee have an Admira= tion that it Should be possible things so small should Exist. and /as\ wee thinck it Im= possible a watch with all y^{e} Comon /clock\ move= ments, Impossible to be made, In y^{e} bigness of a Mustard seed, becaus wee cannot doe it, so wee thinck an animall in pepper water supposed to have all y^{e} ordinary conduct's of life as greater have, a kind of Miracle; and did not microscopes shew, wee should Not beleev 'em, and the Imagination of any living crea= tures less then they, wee account a dream or figment, & with S^{r}. Is. N. Comentitious.[224] there=

All p^{r}judicate Ideas of Magni= tude must be layd aside.

fore Wee must Necessaryly abstract all these Ideas of magnitude, by laying aside every p^{r}judiced opinion of it, and particularly what proceeds from y^{e} gage of our owne per= son's & capacitys, and thinck all magni= tudes alike, the difference lying onely In proportion or comparison, or y^{e} Mind will be very Infirme & lame, as to phi= losofick ways of thincking.

And to Render these regulated Notions of Quantity more plausible: I would have it

[224] 'S^{r} Is. N.', i.e., Sir Isaac Newton; this gives a date after which this part of the text must have been written, Newton was knighted by Queen Anne in April 1705.

No absolute Mag=
nitude, but all
under ye Same
mode, or figure
are alike, for all
yt can be affirmd
of one Globe is
affirmable of all.

it considered, that in truth there is No ab=
solute Magnitude, but the very being of it
consist's In comparison, and take away
~~from~~ comparison and Every Magnitude (other
Modes conforming as figure &c) are alike.
as a Sphear of Globe, is the same thing
whither that terraqueous, or a mustard
seeed, If comparison be Removed. ffor, that
~~a par~~ apart, Nothing can be affirmed of
the one, but is true of ye other. and If all ~~that~~
can be so affirmed equally of one and other
I thinck they are alike In all things so affir-
mable. as filling place, devision as Infinitum
~~&c~~ whence follows ye same number and
proportion of parts: Then what Remaines
but Comparison or proportion of one body
agt another to distinguish them, and what
hath No distinction is ye same. This Resolves

The Sofismes of
ye academicians
about Magnitude
dissolved.

the academick scruple concerning the
true magnitude of thing's, wch they say is Not
any way to be perceived or found out by
us. very true, becaus comparison Removed
there is No true magnitude. but Supposing
but one body In ye World, whither great
or small, In our fancy, In truth it is all
one In nature. for It can onely be affirmed
as a thing Extended, and If it hath any
Extension it is devisible In Infinitum

so

so, as before, y^e^ consequence is the Same Greatness & litleness hath No Existence in one single thing. This I know sounds odly, for they will say a body ~~is Etc~~ ex= tended is a thing determined whither comparison be made or Not; as If y^e^ Mag= nitude be stated by Comparison of another and that is annihilated, y^e^ former remains In y^e^ Magnitude, as ~~it had~~; true, but y^e^ Com= parison In o^r^ mind, is Not annihilated for that Remaines, and gives a Compara= tive Idea of y^e^ other. But then they will say, It fills so Much Space. that is still y^e^ same thing, vis^t^ comparison, with some Imaginary Measure, called space, w^ch^ occa= sions me to speak of that.

Comparison by memory, or In our minds hath y^e^ Same consequence as to magnitudes, as reall comparison.

. 2. It is a very nice distinction between space and that w^ch^ it Containes, that is between something & Nothing, truely; ffor that is it. those who say space is Empty, say it is No= thing. and yet the same people apply the distinction of absolute & Relative to Nothing, yes. but wee account Space according to the limits w^ch^ are something, that is Extended, and ac= cording to y^e^ Imaginary lines from one point of y^e^ Imaginary limits to another, designes the Extension of y^e^ Empty space. but where are the Imaginary limitts? The author says a watch

of the Nature of Space, & how dis= tinguishable from body.

a watch upon a table in a ship, hath a place relative to ye Caban, fixt, but Re= ferring to ye Ground, Movable & Inconstant.[225]

No absolute Space can be supposed as a thing fixt & Immovable to wch any thing Can be Referred.

But there is Space absolute, to wch all things may be Referred; and that is eternally fixt, & Imovable. Now if ye world be ~~fixt and Im~~ Exquisitely filled, there is Nothing /in it\ fixt or without chang, and then, I am sure, Empty place, or space absolute is a [Non-exs?], to wch it is Insanity to Referr any thing. but say's ye author, the world is a great va= cuum, and place in it, is as true, as if it were full of things, all resting, or unchan= geable; so here & there, May be as well Re[=?] ferred to absolute space, that is /to\ some de=

All place is Re= lative, either to ye limits of ye world (If any) or to thing's prcon= ceived In it. but place absolute in vacuum or space Infinite is Nonsens.

termined part of this Nothingness, they Call & Imagine to be Empty Space. Now Either the world is limitd or Extended in Infinitum If it be limited, then place, is Referred to those limits, & it becomes Relative againe If it be Infinite, then I desire to know where is place absolute in vacuo Infinito. It was reasonably maintained by ye Impugners of ye atomicall phlosofy, that Motion In vacuo Infinito, was, rest, or what you plea[se?] ffor there is neither here, nor there in Infinity. As If you abstract so violently as

[225] This is, of course, Newton's own powerful imagery, employed in the 'Scholium on time, Place, Space and Motion' at the beginning of the *Principia*. The terminology here, as in other parts of RN's MSS where time, place, space and motion are discussed, is dominated not only by the image of the ship moving in the moving environment of the sea. As we know from his Notes of Me, (*Notes of Me: The Autobiography of Roger North*, ed. Millard, P. T., University of Toronto Press, Toronto, 2000) RN was an enthusiastic sailor and something of a self-styled expert on boats and sailing. That may seem an irrelevant point, but it enables him often to charge the imagery with his own memory and experience.

as to Imagine but one onely body In the world, & that to be otherwise vacuum to Infinite, Nothing can be affirmed of this body as to here or there; but Every thing y^t^ can be affirmed in any place, is equally affirmable of it, In Every place. ~~It is More~~ so Senceless /is it\ to say In vacuo Infinito there is place absolute. ~~And~~ /ffor\ at the same time as any one disputes against me, they by their owne way of thinking Contradict themselves. ffor pronouncing y^e^ word place or space, they have their owne body's or some other In their Minds w^ch^ they Conceiv, tanquam absoluta,[226] and by that they rule their opinion's. and

The reason why wee cannot purg o^r^ minds of abso= lute place; vist^t^ Re= ference to o^r^ owne person's p^r^sumed as such.

the reason folks cannot purge themselves of this Idea of absolute place or space, is there is No Moment of their lives In w^ch^ they are free from Such Imagination, as of their owne homes, the Church; and philosofers goe so farr for it as to y^e^ sun, & fixt starrs. according to w^ch^ place, may be accounted absolute, ~~In~~ /and\ all y^e^ tossings of y^e^ Sea, be Referred to that. Now If even y^e^ Sphera fixa= rum[227] Changes place, then wee are lanch't a= gaine, and so Continually, that without ffixing limits ~~In~~ /of\ y^e^ World, there can be No such thing as absolute space or place.

But It is very considerable to Remarq that

[226] i.e., 'as (being) absolute'.

[227] i.e., 'the sphere of the fixed stars'.

When any bo=
dy is conceived
as In vacuo In=
finito, there is
a determina=
tion of its aspects
Every /way\ to
Infinite
reall & true, ye
is to be Remebd.

Any Extension
Given, there is a
Measure of all
distance, by ap=
plication of that.

that as soon as any Existant thing is Given
In vacuo Infinito, at ye Same moment there
is a determination of all space round it, [to?]
Infinite, with relation to ye center of that.
And one side not being ye Same as ye other,
you have as it were an universall Com=
pass, whose Ray's Might denominate the
univers, as that of ye Mariner's doth the
plan of ye horizon. here I suppose No Motion
Reserving it to proper place. And so soon as
any Extension is Given wee have distance
also given, ffor by ye measure of that distan=
ces are taken. but what If 2 or More I=
Maginary point's, or Center's are given w/th\ou[t?]
any Extension. It will be Sayd there is a
certein space betwixt them; but at the Same
time the pronouncer, hath an Idea In his
Mind by wch he Makes Such an account, bu[t?]
abstracting that, I know Not how to Re=
concile the Notion's of. 2. Nothing's, In
Nothing, with Nothing between, to have
Something certein & determinate Inter=
posing betwixt them. therefore, that wee
May Not allwais talk in circle & come
round to ye Same discour's againe; that is
when Nothing, yt is vacuity, is Called Some
thing, that is space, to answer still that
Nothing

Argument from absolute space, y^t^ space & body is y^e^ same thing, becaus one space cannot be where another is

Nothing is Nothing, wee must ffix in this
opinion, that space & thing's conteined
are one & y^e^ Same, and there is Nos~~s~~Such
thing as place absolute, or taken abstra=
tedly from y^e^ thing's In y^e^ World. And to Con=
clude let me subjoyne this Remark. If place
be absolute, then Every place is severall,
and one place Cannot be where another
place is, and y^e^ place of a place may be
Senceless tautology, and Endless also. Now
All ~~wt~~ wee /surely\ know of body is, y^t^ It keeps its
place, & will lett No other Into it. and two
body's cannot be in one place; What then
is the difference between body and y^e^ place
it hath. for y^e^ place, If it be any thing besides
y^e^ body, as these gentlemen say, y^t^ is what
would hold another body if that were out,
It holding out also, all other places; so as a
Coincidence of places, is as Impossible, as pe=
netration of body's. I Referre it to Candor
If Cartesius, was such an unthinking Sott
as y^e^ accademicks make's him, for saying
place, & body were one Notion y^t^ is Extension,
and the fancy of Extension penetrable,
is litle less then a Contradiction. I beleev
y^e^ vote of y^e^ Greatest part of Mankind Will
as they would have it be against him,

But

But as Men can force themselves to thinck clear of p^{r}judices, and distinguish between Imagination & things really Existent without us as he did, and have No politiq to Corrupt their Sincerity, as some Hierarchys have, so Will they begin to ~~In~~ owne that he had more ground for such tenent's then they were aware off. What My aime Is I have declared, and as free as y^{e} air I hope to persue it.

of Motion and y^{e} distinction of Rela= tive, and true, w^{ch} is of like sort. for ab= solute space, & true motion are alike No= thing.

3. The Next head is that of Motion, with its alternate, Rest. w^{ch} y^{e} Same author say's admitts y^{e} Same distinction of Rel= tive and true, or verus. ffor say's he the Rest of the watch in y^{e} Caban, is Relativus & Not verus; so a ship at anchor In a tides way, hath y^{e} Same appearance with y^{e} water, as one that sailes thro it. but It is only Motus Relativus & Not verus, for y^{e} place with y^{e} Earth is allwais y^{e} same, but then, there is motus Relativus of y^{e} Earth it self Referring to y^{e} fixt starrs. but It is hard as he ownes to distinguish between motus verus & motus Relativus. And yet doth Not despair, for he proposeth Expe= riment's of turning, by w^{ch} he would prove that y^{e} Recess from y^{e} center Consequent

Experiments of tur= ning to prove the verity of motion to be considered afterwards

of

turning is Motus verus, & Not Relativus. I Shall not here Examine those Experiments becaus they Require aid out of y^e^ theory of Simple & Complex motion's, to dissolve the Enigmatismes of them, but I Shall apply onely to y^e^ Reasonable part, of y^t^ opinion, & as to that much of y^e^ Work is already past, ffor If there be Not place absolute, there cannot be Motion such as he Calls true and Not Relative. ffor Motion is but changing place, and therefore is Referred to and knowne by y^e^ places concerned in that chang. And If those places exist In Relation onely to things that fill places, then motion Must be Onely relative, as y^e^ places changed are.

The solution of this distinction de= pends on y^e^ theory of motion;

But All these discourses are Idle, Untill the Idea of motion be clearly Explained. ffor When one say's, there is a seeming Motion w^ch^ is Not Motion, and there is a true Motion w^ch^ seem's or may seem Rest /& y^e^ like\ one would thinck it the language of a person Either Imposter or distracted. And therefore untill I have dispatch't the theory of Motion I cannot p^r^tend fully to dissolve this Captious distinction; And therefore y^e^ full discussion of it Must be had from thence. And here I shall onely give a Short Sumary of what is Intended to be at larg Explained

a sumary of that theory for that por= pose here Given.

& y^t^ is

Motion is No other but Chang of dis= tance, & position between given bo= dys. so is all Rela= tive, & hath No Es= sence apart from body.

the word Motion is an abstract wch is taken ffor a Noun Substantive & yt Ca/u\seth Error.

distance & position are allwais true, & hold by certein measures, & aspects so Whither chang or Not chang in yt Respect is true & not Relative. & ye Relation Comes in when one or other on= ely is regarded.

And that is that there is Nothing In Motion but what concernes more then one body Becaus the Existence of it is onely chang of distance and positure of body's, In pleno; When Such Continues ye Same it is Called Rest when changing Motion. And Motion is the abstract Word, Wch language hath from a vulgar Idea (derived from our feeling sence) taken into Comon use, and In other cases Would Not be Endured. as to Say the falling= ness of a thing that falls, or risingness of that wch riseth. or Indeed, ye Movingness of a thing wch Moves, and In truth ye word Motion is No other. And It will ~~appear~~ /Sound\ very Strang when It Shall appear that Motion is In it Self Nothing, or (In other words) to have No Essence at all apart from body, Nor that a body hath any thing more or less in it Moving then Resting to hear it Say'd, that there is a true No= thing (or Motion wch of it Self Is No better,) & a Relative Nothing. What May be affirmed of body's, vist. that they ~~May~~ /either\ chang, or Con= tinue alike, as to distance & position, Must be allwais true, and Cannot be Relative as ye Case is. So In that Sence Motion is all= way's true, and Never Relative, but When the chang is as to Some, & Not to others, then the fancy of Relation comes in, to No other porpose, but /when\ In ye application of ye Idea you Regard

Regard divers things, & then Charg Motion with Nonsensicall Equivocall propertys /If Not Contradictory\ Such as to be true & fals together. I have often Re=

Reason of such forc't distinction is to thwart Cartesius who defined Motion by y^e^ vicinia,[228] y^t^ is by Relation.

flected on y^e^ reason such an opinion Should come in y^e^ front of a mathematicall book and Can find None, but to thwart Cartes, who defined Motion by Relation, but of this More afterwards, where the Notion will be Made appear to Include a very Contradiction. It is a plausible style to distinguish formally, & aptly to Serve turnes, as motus verus and motus Relativus; but when Motus is Rightly considered, It may be as well distinguish't as M^r^ Hobbs Rall÷/y\es, Into Titericè & hipatu=lice.[229]

Time is but a Col=lation of moved spaces, aided by certein periods or coincidences, w^ch^ shew that things are successive, and no co-Instant.

4. our Next article is that of time, w^ch^ wee have agreed to be Coincident with motion, as the termes are, mensura Motus; under wee know well Enough what our meaning is tho y^e^ Expression is Not Exact. ffor it is rather collatio Motuum. ffor by comparing Motions whereof one is stated, & hath y^e^ place of a comunis mensura,[230] wee make our acc^o^ of time. And because of y^e^ perpetuall Retur=ning wee take the circular rather then y^e^ Rectilinear, w^ch^ is Not so accomodated with Returnes to serve for periods, as the circular is. & of these the annuall orb of

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[228] i.e., 'neighbourhood', in the sense 'relation to neighbouring things'.

[229] RN quotes (inaccurately/freely) from Thomas Hobbes (1588-1679) writing towards the end of *The Questions Concerning Liberty, Necessity and Chance*, 1656, (*see*, *The English Works of Thomas Hobbes of Malmesbury, Now First Collected and Edited by Sir William Molesworth, Bart*, Vol. IV, London, 1840, p. 277) "I know there be some that say, it may be necessarily true that one of the two shall come to pass, but not, singly that it shall rain, or that it shall not rain, which is as much to say, *one* of them is *necessary*, yet neither of them is *necessary*; and therefore to seem to avoid that absurdity, they make a distinction, that neither of them is true *determinate*, but *indeterminate*; which distinction either signifies no more but this, one of them is true, but we know not which, and so the necessity remains, though we know it not; or if the meaning of the distinction be not that, it hath no meaning, and they might as well have said, one of them is true *Titirice*, but neither of them, *Tu patulice*."

[230] i.e., 'measure of movement', 'comparison of movement', and 'common (i.e., agreed) measure'.

of y^e Sun, and under y^t y^e diurnall cours of
y^e Earth, w^ch with automata Contrived With
coincident periods & subdevision's, wee
make out an acc^o of years, day's hours &
minutes, the numbring of w^ch is our account
of time. and comparing y^e Movements, as if
one index makes 12. Returne's when ano
ther make's but one, it swifter as. 12. to 1
and so works, Races, delay's, and all affairs
that depend on such comparison, y^t is time, are
adjusted. but here all exactness is p^rsumptive
and Not reall. ffor It cannot be found y^e year
day's, & hours, are Exactly Equall with them
selves or Commensurate, or aliquot[231] parts
of each other, as the propostition Requires.
but whither more or less, like all practick
mensuration's, It answer's the end of huma[n?]
affaires as well as If it were so, w^ch makes the[m?]
Not very sollicitous about it. but artist's
have bin curious In contriving automata
upon a pendulous principle, w^ch Measures
time with very litle Error, and Whereby
have bin discovered diver's Inequalitys of
y^e planetary courses, Not otherwise to be
accounted for.

Exactness In y^e acc^o of time not ma= teriall, but artists have strove to gaine it, and are come very near by pendulous Mo= vem^ts.

The former dis= tinction Returned of tempus verum & tempus Relativa ffor absolute or true time

But wee are told, that however the
account of time with us is unequall, be=
caus it is Relative to actuall Movem^ts
y^t

[231] i.e., 'some such' or 'such like'.

true time doth Not depend on body or motion, to be Incer= teinly acco^{d} ag^{t} that is but Equably, & is Not time but Duratio.

that are In themselves not rightly adjusted, But true time that is /tempus absolutum [vel?]\ duratio, is allways Equable, and flows accordingly, and doth Not Relate and depend upon body and its motion's at all, but would be y^{e} Same If y^{e} whole world were annihilated. And wee are Chidd for Erring, & taking the measure for the thing; as when wee Say time is the Com= parison of movements, wee ~~measure that~~ /mistake for that \ is but our Cobled Measur of time. but time It self as it flow's Equably, is, as was sayd Independant on Motion. thus stands y^{e} Case with us, and wee Must see how wee can get off. And whereas It is sayd that time flows

Time equable, to what? hard to ans^{r}

Equably, I demand to what? I am sure take away body, and Edipus[232] Cannot answer y^{e} Question. This opinion Seem's to Establish time as well as space, In absolute Essence, Independent Not onely of body, but of y^{e} Great Creator himself, and so Make dietys of them. wee may as Easily Imagine No time or duration, as No space or Extension.

The opinion Makes time coordinate with y^{e} deity.

And this terme absolute Imply's a Necessity of them according to their Nature, as Necessa= ry, whatever becomes of the created, or If you pleas Existent being's In y^{e} World; but In Short I Must Say Now as before, this Notion of tempus absolutum, is a rank and a perverse p^{r}judice of life. ffor it hath No other

[232] i.e., Oedipus, who answered the sphynx's riddle, although not to any lasting benefit of his own.

The Non-abstrac=
tion of time, is from
vulgar p[r]judice of
life. for wee all=
way's see chang
& thinck y[e] Same
must allwais be so.

no other root, then our being tyed to time
& Extension, without y[e] least Notice by Sence
of a possibility, there Should be a privation
of Either, and so y[e] opinion is Concluded, &
Not ~~from~~ /out of\ any necessity at all from y[e] Nature
of the thing, our sence, abstracted, but to be
better understood, I shall Give in My senti=
ment of y[e] whole matter.

Abstract sence
& time & motion
In Nature are all
/the\ one and y[e] Same
thing

With universall
Rest time ceaseth.

Time is but a Consequence of Motion, that
Is what In our conception is time, In nature
and without us, is the same thing as Motion,
So as Motion gives y[e] Consequent Idea's of
light & sound, so Motion, that of time. And
If all perception or Imagination were taken
out of y[e] world, Motion would Remaine with al[l?]
the property's & modes of it, but the Idea Wee
have of time, as a being Independant on body
is gone. And If Either body it self, or all muta=
tion's of it, y[t] is motion Were taken away, and
all thing's Rested, time it self must vanish &
be No More. I am so farr from allowing such
an Essence at tempus absolutum, that I thinc[k?]
it is Not onely Related /too\, but all one with Ex[=?]
tension. , Those of another opinion are Wholly
at a loss for any manner of description
or account of what they Mean by y[e] word,
when you take from them the Relation to
body; ffor upon y[e] Question they give you
an

an answer In synonima's, as duration, Con=
tinuance, & I know Not what; and being
prest, they say they Cannot Imagine but that
ffore & after must necessarily allwais be.
but what is our Imagination, to y^e^ truth of
thing's In Nature?

wee are charged
as taking mea=
sures of things for
thing's. but time
is meer measure
of spaces moved, or
what is it?

S^r^. Is. N. Reprehends y^e^ notion of Cartesius, for
making body & extension y^e^ Same, and Say's
that y^e^ mistake of taking the Measure (that[233]
is Extension, for the thing that is body, leads
to Many Errors. And this Conceipt he translates
to y^e^ buissness of time, Supposing our account
of it, as being the comparison of Motions, is
the mistake of y^e^ Measure for the thing; and
so philosofy & Geometry are Confounded; What=
ever may be p^r^tended as to Quantity of substance
that y^e^ measure is one thing and y^e^ Matter
another (w^ch^ is a dispute of another place,)
he cannot apply that objection to our Notion
of time; ffor he cannot p^r^tend any thing is
subsisting under our Idea of time, but y^e^ very
Notion of it is a Notion of meer Measures
& Nothing Els, that is of extension's compa=
red. And here ly's a fallacy Couched In y^e^ Word
measure, as Relating to practise; ffor In truth
it is y^e^ very Idea wee have of thing's w^ch^ are
perceived under extension, w^ch^ is a measure.
therefore

Measure is a word
Not proper In phi=
losofy, but practise
of arts & trades. & so
carry's a p^r^judice
as when y^e^ cloth and y^e^
yard are made one
thing

[233] RN forgets to insert the second, closing bracket - presumably meant to go after the word 'Extension' on the next line.

Take y^e word Ex=
tension for Meas=
sure, & then say
body & extension
are all one. y^e o=
ther say's y^e Error
is In making the
extension y^e thing
w^{ch} is y^e point In de=
bate & Not cleared
at all by changing
y^e Word; but this
is more apparent
sofisme as to time.

Wee cannot thinck
even of angells
or spirits, as un=
Extended things
but under an
Imagined Idea
of Extension; so
to us it is y^e Same
as If they were
extended.

therefore chang y^e Synonima, and take y^e
word Extension for Measure; becaus y^e latter
ffrom y^e use of tradesmen & calculator's hath
obteined somewhat of a more Restrained Sence
and then y^e ~~Mistake~~ /Error\ lyes in Mistaking (as
he Say's) Extension for body; And that is y^e
assertion In debate; that one side affirmes
& y^e other deny's, they are y^e Same, is Granted
but farther then a denyall, is Not Granted, &
the putting y^e word measure In y^e place of
Extension, sounds a litle different, but is In
truth y^e same, and Carry's No further argu=
ment at all; Much less as to time, w^{ch} is very
Measure /itself\ y^t is the coincidences & Non Coinci=
dences of termes, or periods of corporeall Mo[=?]
tion observed. and Whither body be meer
Extension or ought Els, It is all one as to
time, w^{ch} is onely y^e Motion's of that thing
filling y^e Imagination, from whence y^e Idea of
time Results.

The Essence of Extension Consisting In More
& less, is understood, such Notion being onely
to be had there. ffor If wee take Comparison
Not In Measure but In Number (w^{ch} In
Comon acceptation is y^e Same thing, that is
Number of Measures) and let y^e Number be
of things Not Extended as spirits or angels
w^{ch} have No Extension or place. yet when
wee

wee Say, 100, or. 1000. Spirits or angells, wee must feigne In our Imagination places In Extension for them. therefore In our Imagi= nation, or rather Capacity of thincking Even Non-Extended things are Extended & p^r^ferred to places; Els wee Could Not thinck of them at= all, for wee doe Not thinck /but\ of place and Ex= tension, from whence, that is from our sences, all our formed thoughts come. Here is y^e^ folly of Such as conclude against all Non-corporeall things, Made apparent. ffor they say None Such can be conceived, or all our sentiment's are of body, true; but how comes y^e^ Nature of things to be Restrained to our Sentiments? It is No better to argue that since wee can have No Idea of Non-time, therefore there is allwais time, and it is an Essence distinct from or In= dependent on body, y^t^ is tempus absolutum.

Such as argue y^e^ Ex= istence or Non ex= istance of things from our manner of thinking, doe In= jury to truth.

I must with others owne it a very difficult abs= traction, such as common Men cannot, and philosofers rarely If at all Maintaine In themselves. And when Ever I Remitt My thought[s,?] or Take off y^e^ Constraint My reason holds over them In this & the like Speculations, Immedi= ately the fancy of Equable time Emergeth. and it is very difficult to keep it downe, and Nothing will doe it less then then an

Abstraction of time a very hard thought and ffew able to hold it.

absolute

The best mean's is to goe from thin= king to thing's.

Resignation to this truth, that My thoughts one way or other are No laws to Nature, & ye possibility of Existence, & Non Existence of thing's, and that for the truth of them I must goee out of My self and search for it as Well as I can; And by that Method I find Nothing of time but what is Coincident with body & its changes, and consequently Coevall With it. I shall Not deminish sacred Authority In citing it In these secular & frail Essay's, but If any thing of Nature be Expresly Re= veled & declared there, it is that time it ~~Sl~~ self had a beginning, & Shall have an End, when, as it is worded, time Shall be No More.

sacred authority shew's time is to have an End.

Time In our sence is so Incertein as to be without all Measure, as if it might as well be No thing as any thing

I cannot leav this subject without a ffew More Reflection's wch occurr to My thoughts, ffor Con= firming this Judgment I have made of time. It seem's ye Mind is Not Engaged Strictly to ye Measures of things, or account's of Motion; for then time would be to us as Motion is, and wee Should keep ye account of it without ye help of clocks, or horologues. but on ye Contrary, No= thing is more Incertein to us then ye account of time; ffor as wee are pleased, or offended wee account it short or long; and that gave Mr Farfaix[234] an odd tho No unlucky Conceipt that ye diety In perfect happyness was Not

subject

[234] See note on f. 12v, above.

The scoolmens Nunc stans.

subject to time, but all thing's past & to Come were a perpetuall p^r^sence. the Scoolmen had Such a conceipt; they were No poor thin= ker's, Nor allwais unhappy In Expression. they sayd ~~time~~ /that\ to y^e^ diety, and perhaps to all being's that thinck free from matteriall Impres= sions, time is a perpetuall Nunc stans.[235] Now If time were a thing Self existent or Indepen= dant on body, y^t^ is absolute, how comes it to be with us sometimes as Nothing & sometime[s?]

Attention or Non= attention gives more or less of time for us.

very tedious. In our Method I can Resolve it; ffor In pleasure y^e^ Mind is Not attentive to y^e^ Marks or periods of moving thing's, or to Many Numerous Sensation's, as might give Notice of time passing. but In paine, those numerously obtrude, and what with direct sencation, and passion not without hopes at successive periods of Releif, y^e^ Mind is attent to all circumstances, w^ch^ creates an opinion

If No Corporeall marks or fluxions or periods, No time.

of length. What is time then, when No Marks or periods of Motion Could be observed, w^ch^ wee p^r^sume is y^e^ Case of discorporeall beings? Surely there is to them No time at all. I thinck truely, that this Consideration of y^e^ Inequality

Inequality of time demonstrates a State of y^e^ Mind Separate from y^e^ body.

of time, as it is stated to us In our Imagination Rightly considered, amount's to litle less then demonstration, that our Minds are being's dis= tinct from however, in some sence annexed to

our

[235] i.e., 'the eternal now'.

to our body's. ffor If it were Not So, time Must
be Equable as they say that it is, at least y^{e} Same
step by step as y^{e} Motions are w^{ch} gives us the
Idea of it. And No such deceipt would happen
as wee apparently ly under by taking time
Short for long, & long for Short as Every one know[s?]
and of this Notion use May be made in another
place.

Hypotheses & Experim^{ts}. 1.

It is certein that truth is not without an hypothesis
for y^{e} Cours of Nature is uniforme. And there is analogy
of causes, so that one may see Many thing's depend
on ffew principles; This being so manifest, It hath
bin y^{e} practis of all naturalist's to Invent princi=
ples, and by conclusions, or rather arbitrary appli=
cations of them, p^{r}tend to Resolve all Naturall doubdts
And If the machine be so dextrously framed, that
the operation's of it Cannot be proved Impossible, y^{t}
is Implying contradiction's, or Notorious Inconsistencys
The Engineer triumph's, as having Gained his point.
This they call an hypothesis, And If every any one
was Inconfutable, it was that of Aristotle, who had
words to answer Every demand. And the late one
of mutuall attraction is somewhat like it. but
Cartesius, ownes that /Re-\solving Question's, is No ar=
gum^{t} of truth, and an hypothesis is Not to be Re=
ceived becaus it is apt, but becaus it is true. there=
fore, the search of an hypothesis is Not by adapting
Invented principles to Resolve y^{e} Effect's of Nature,
but to Search among Effects to find what is reall &
permanent In Nature, and being sure of that, use
it as principles, or hypothesis so farr as It will goe.

And In this Method I propose first to be sure what
is, then Inquire what consequences Necessarily ffollow
from it; and look not ffor any principle from ap=
tness, w^{ch} is No proof, but from Necessity. and so farr
as this

as this path will lead us wee may Safely goe, and
No farther. And In this track wee find the Necessary
Existence of Body, then that It moves, and Moving
Must produce changes. ~~of~~ for one thing Cannot goe
Into or thro another. And If by help of these, wee Shew
Either Effects are necessary wrought, or by necessary
working, may possibly produce y^e^ effect, wee have all
that can be p^r^tended too In Naturalll philosofy. Now Some
will ans^r^, that this Hypothesis is Not Sufficient to Resol=
ve /all\ the phenomena of nature. w^ch^ is y^e^ sume of w^t^ D^r^
Barrow objects to the Cartesian philosofy, and is ra=
ther opposed to the p^r^sumption of y^t^ author, then to y^e^
truth of his principles; whome to say truth, he allow's
p^r^ference to all philosofers y^t^ Ever were in y^e^ World,
So Just are y^e^ way's of good men, suum cuiq tribuere[236]
prais where it is due, and blame where demerit is.
but the mode of writers, lecturers, & disputers, is other=
wise, If ought hold Not up Equally, but proves obnoxious
to objection, the whole fabrick, & not those Excrescences
onely are attaq^t^. Wee Allow this Corpuscular hypothesis
Not sufficient, according to our narrow Information of
thing's, to satisfy us with demonstration In every Instance,
but then wee know it to be true so farr, as May be
demonstrated, w^ch^ is to the most Comon & generall
Effect's, as may In due place be Shewed. And as to Which
It falls short in, that is In y^e^ province of particulars
w^ch^ are to us darkened by unsearchable Minuteness,
wee Must be content, & Expect farher Information.
ffor it

[236] i.e., 'to each his own'.

for it is Much better, Either to be suspended In o=
pinion, or Els contented thus farr, as /that\ If the neces=
sary Consequences of matter and Motion May pro=
duce certein Effect's, w^ch^ for reason's hinted Cannot be
trac't to their principles, wee Incline to thinck the
causes of them are from thence, untill Some cogent
confutation comes; And this rather then Make Ig=
norance a ground of Invention of somewhat out
of Nothing, w^ch^ perhaps as wee may fondly or Mista=
kenly thinck fitts y^e^ Case better. As for Instance, Wee
know body's drive one and other by Imediate Contact,
but wee know Nothing of attraction, whereby a body
at distance Shall make ~~it~~ /another\ Move towards it, Especi=
ally, If a vacuum Interpose, as some dream; Shall
wee Not therefore choos the opinion, that all body's
are driven, & not /so\ attracted; rather then that they
are attracted, wee know Not how, & Not driven as
wee see things done, & onely so, Every day? Sure
there is No Comparison. but this Gaining Ground by
Stepps, some adding to y^e^ Invention's & discovery of
others, and Content what can be reasonably ~~gai=~~
advanced, or els what is already gained, doth Not
aggre with y^e^ appetites of Some, w^ch^ is to pull downe
or set up all at once, and must Not hear of any
failing or defeat In any thing they deal in. but
This is for Glory, More then truth. And wee are content
with an hy-pothesis out of certein principles, or <u>None</u>
<flourish underline>

4. Hypotheses & Experim^{ts}.

All our mean's of Naturall knowledg, Is from Experiment
ffor what doe we know but thro o^{r} senses, and what is
Experim^{t} but the application of our senses to things, &
attending to them. But The Experiment is one thing
and the Judgm'^{t} Grounded upon it, and there May be
Experiment;'s Enow, and yet people have litle know=
ledg from them, w^{ch} is y^{e} Case of y^{e} vulgar, who live Move
and have a being, and yet understand litle truth
of what they dayly Convers with. Therefore It is Not
So ~~E~~Much Experiment is wanted, as a right way of
consideration and thincking upon them. ffor the Com=
mon occurrences of thing's, In buissness, Manufacturys
and Recreations afford Experiments to give us as Much
light into y^{e} Nature & truth of things as wee are Capa=
ble off; w^{ch} y^{e} sagacious Cartesius hath shewne, he ha=
ving, In that great Structure of his hypothesis, used
ffew, or None but vulgar occurrences, as Every one
knows ffor Experiment's. Therefore I cannot agree With
y^{e} lord Bacon, who is for Suspending all hypotheses,
and hunting for one, In y^{e} way of experiments; And
upon that modell is our Royall society ffounded, who
propose to themselves, that out of such a Collection
of Experiments as they In time may make, a perfect
Hypothesis of nature may be Extracted, videlicet, ad
Grecas calendas.[237] ffor If that had bin a rule universall
wee had lost y^{e} Endeavours of almost all the Modern
vertuosi. Therefore I am for proceeding upon y^{e} Stock
wee have as farr as wee may; and Rest in suspence
as

[237] i.e., 'namely, until the Greek Calends', meaning: 'which is to say, we will wait forever'.

as to farther advances, till time produceth some Great
Geniuses, of a Boylean Spirit, who may by formenting
nature squeeze out somewhat farther. and discove=
ry's, may be rare, but Never desperate, ffor what vast
Information's have bin gained, not of flys & Insect's
but Concerning y^e^ /whole terraqueous\ Globe ~~of Earth~~, by one accidentall
proof, and Not Much vexed Experiment of Torri=
cellius, Now vulgarly used for progostick of y^e^ Weather.[238]
~~That one accidentall~~ I am bold to Say there is more
true knowledg /of naturs [....?]\ from that one discovery, then from all
y^e^ discovery's that have bin made in Experimentall
philosofy, Since y^e^ Restauration of learning; And Setting
aside the Copernican Systeme & discovery of the
Satellites, w^ch^ were brought forth about that time,
I scarce know any thing considerable; The Systema
Saturni is very Ingenious, but Exceeds not y^e^ outwards
forme of Saturne, so the Rest of the telescopian world is
more for curiosity & pleasure then knowledg. And the
whole microscopian trade comes to very litle Els.
The circulation of y^e^ blood, hath altered very Inconsi=
derably y^e^ practis of phisick, more then removing y^e^
fancy for topicall bleeding. The transfusion, Nothing.
The texture of some part's In animalls, a litle more
disclosed, and new series of vessells layd open, but
serving cheifly to Shew, there is More then as Much
more beyond. Infinite animalls discovered, More then
former ages dreamt of, w^ch^ with me open's a New
prospect of diseases, as plagues & y^e^ like proceeding
at time

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[238] i.e., the barometer; RN's review of recent advances in knowledge is remarkably phlegmatic, and something reminiscent of Gulliver's response to the achievements of the Academy of Laputa. RN is, of course, thinking through the science of the seventeenth century in terms of what he considers a contribution to natural philosophy, as against what has contributed to natural *history*.

at times, from Swarmes of animalculi; wee find wormes
In y^e^ body, as stomack & bowells. why not in y^e^ blood
and y^e^ juices, & why Not more malignant when
season's breed them then at other times?[239] And how
far anumalculi are concerned In ordinary Corruption's
I may Not Say, becaus I know Not, but beleev it
Not a litle. ffor It is Comon to see y^e^ ordure of a Cow
macerted to powder & spread abroad, like the Con=
sequences of corruption; And Stirr y^e^ mass, & It is ffull
of a peculiar fly lodged there, w^ch^ wrought that alte=
ration. Great things, may give light to Smaller. I have
made a short Enumeration to shew how litle the
principles of philosofy are advanced by the ~~the~~
Experiments of most Eclate.[240] And on y^e^ other side
to doe right to both, I can shew how from a Shep=
heards sling, y^e^ Recess from y^e^ axis of turning Move=
ment's is discovered, on w^ch^ such vast Consequences
In Nature depend. Then y^e^ game's of billiards, Tennis
shuffle-board, & bowles, have administred proof of
almost the whole theory of Motion. And Whereas
that as yet hath bin Cultivated onely in Regular
Cases, & most If not wholy upon Globous formes, &
litle of Nothing touch't of Irregular's, I have Endea=
voured to add a theory /of them &\ of Irregular ~~Motions &~~
Impulses, by w^ch^, More then y^e^ other, y^e^ ordinary Miste=
ry's of Mechanisme, as y^e^ Movem^t^ of obliques, ~~as~~ /exemplifyed in\ Wind=
mill's, and shipps sayling, /And those\ So puzled in M^r^ Pardies
are lay'd forth to open view. And I use No Experm^t^
for

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[239] RN is ahead of general science here. Girolamo Francastoro (1476-1553), a physician and polymath teaching at Padua, a scholar especially preoccupied with the notion of contagion, and the man who gave 'syphilis' its name (in an epic poem of 1530 called *Syphilis sive morbus gallicus*, 'Syphilis or the French Disease') had suggested that microscopic entities, or spores, caused and spread disease. The idea was not a new one, it has various forms in undemonstrated assertions found in various ancient medicinal texts. Francastoro was conceivably adopting the notion in the same framework in which he adopted the atomistic ideas of Epicurius. Note that there is a strong Epicurean strain to the Cartesian theory of matter (tiny and tinier things; the ether) which carries through into RN's own notions of the infinitely divisible 'exility' of things. It was not until the nineteenth century and the work of Louis Pasteur (1822-95) and Robert Koch (1843-1910) that 'correct' scientific understanding (proofs and applications) of microorganisms, first guessed at and identified in RN's lifetime, were realised.

[240] 'Eclate' is one of RN's many neologisms, usually lightly anglicised loan words. He had an impressive knowledge of foreign languages. The French word '*éclater*' means to burst out, something brilliant, something that attracts attention, something that is celebrated or notorious - i.e., the savants responsible for the discoveries listed above, or perhaps the discoveries themselves. He then contrasts this (flashy) brilliance with his own non-experimental skill in drawing philosophical principles from observing the 'Comon Justling of thing's' (in this, again, he is explicitely Cartesian, who also taught from the rationalising review of everyday examples).

for Example, but that litle Engin of boy's-play
they Call the Catt. What plowman or porter is without
Experimentall skill In y^e^ lever, w^ch^ they Call prising,
and a seaman is a master of mechanicks, and
hath an Expression for his powers, that is, purchas,
for w^ch^ signification No other language hath an
appropriate word; And he Shall to a nicety declare
what purchas any Contrivance you shall propose
hath. Thus the Comon Justling of thing's, to a due ob=
servator, shews /light\ Enough ffor ~~serch~~ search of the
comon principles of Naturall thing's; and y^e^ more
Refined, however ffeeding y^e^ curiosity, and pleasure
of wonder, gaine but Small knowledg In that process.
I Should have Mentioned y^e^ Invention of Gunpowder,
w^ch^ is very considerable becaus brought into y^e^ Com=
mon practis of warr, w^ch^ hath carryed the knowledg
of the most signall Explosion farther, & More diffusedly
then Ever had bin without it. There were Examples
of Explosion before. as aurum fulminan's,[241] water in
Melted Mettalls, & particularly Glass potts in a fur=
nace, w^ch^ bin In working heat, with y^e^ Quantity of
a drop or two, Shall send y^e^ Glass about y^e^ hous, &
dispatch y^e^ Roof of y^e^ furnace, & It may be, of y^e^ hous
it self, as If a mine were Sprang. this I say hath
Compleated y^e^ Experiment of Explosion's, w^ch^ in My
conceipt, will be of very great use, In y^e^ Interpreta=
tion of a Multitude, of almost Miraculous effects
In Nature, as perhaps may be ffully declared here after

But

[241] i.e., 'exploding gold', see note at f. 123v in BL Add MS 32546.

179v

8. Hypotheses & Expermiments.

But I did touch before, & Must here Repeat, that for
dissolving vaine p^r^tended principles, and Subtily Inven=
ted hypotheses, without bottom, w^ch^ rest wholly on
the Confident assertion's of such as pleas to patro=
nize them, I thick /Refined\ Experiments are of Infinite
use, and hath actually bin very serviceable to know=
ledg In that way. for M^r^ Boyle hath demonstrated
that all principles & hypotheses as have bin set up
Except the Corpuscular, have no foundation in Na=
ture, but are affected & fals. This No argument Could
have Ever brought about, So long as men attach't
to them, with their witt could find Evasion's, or
arbitrary assertion's to oppose comon reason & sence,
and Such are Never wanting, when Men are pervica=
cious and willfull. Therefore as I delight In Nothing More
Then the accounts given of all sort's of Experiments,
so I am a gratefull well willer to all the Ingenious
promoters of them, and heartily wish such May Never
be wanting, petulant empty p^r^tender's May Never
hindring /but\ the worthy progress of Experimentall philoso=
fy may ever proceed.

I must Not pass by one Experiment of viewing y^e^ blood
~~s~~circulating In y^e^ pellucid finn of a fishes Tayl,[242] In Shewing
w^ch^, the space of a pinn's head is magnified to above
an Inch. And such hudle of lumps /appear\ swimming in liquer
[marg][243] In vessels of different sizes, & with different Speed Some
one way & some another, that one Might fancy it
a view of all the london Kennells, magnifyed from vast
distance, ~~with~~ after y^e^ breaking /of\ a Mighty frost, when
all y^e^ Watter & Ice, with dirt, /is flowing in them\ & tumbling Every way <u>downe.</u>

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[242] The demonstration of the circulation of the blood by means of viewing the tail-fin of a fish through a microscope (against a bright light) is famously associated with Anthony van Leeuwenhoek (1632-1723).

[243] marg [in tiny letters]: 'Add exp of motion.'.
This is an abrupt ending. The last paragraph appears to be crowded in, and a note is left suggesting the addition of a further example of an experiment 'of motion'. Whether there was ever any continuation is not clear from what survives here.

180r

Experiments,[244] 1.

I doe Not here Intend to give a muster of Experim^ts^
but a Judg'^t^ onely, how usefull they are, and also plea=
sant to one that is addicted to Naturall knowledg. And
Whoever it is that doth Make Collect & Comunicate,
Experim^ts^, is /surely\ y^e^ Greatest benefactor such Can have, as
those that work towards advancing Naturall history
their best Help, and of any, Most wanted; and /I Intend ~~ab~~ also to speak\ ~~also~~ of
the methods of making, & using them.

S^r^. Is. N. In his opticks among y^e^ Quere's[245] say's, that the
method of Naturall philosofy Should be as In Mathema=
ticks rather analitick, then Synthetick. that is to begin
with the pha^e^nomena, and so goe backward accounting
for all y^e^ vires[246] & property's, till you Come to y^e^ principles
and so to the first caus of all things. and Not to begin
With principles, & from them proceed to vires & property's,
ffor Experiment may confute, what is Argued from prin=
ciples. This specious as it is, Shews how y^e^ Geometer May
Eat up the filosofer. I allow him, If y^e^ Cases were alike
to be in the right. In geometry however complex y^e^
case is, it is possible, by humane sagacity, to work it
clear, by tossing /&\ tumbling In y^e^ analitick way. but
It is Not so In philosofy. ffor If a Complex case happen
as most generall phenomena are, It is Impossible for
y^e^ witt, or Is it indeed is it, for want of faculty's, In the
capacity of man, to work them clear by degrees, in
Such method till the case Is Reduced to Simple Instances
that

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[244] This is another essay on a similar theme to the previous essay.

[245] The 'Queries' conclude the third book of the *Opticks: Or, A Treatise of the Reflections, Refractions, Inflexions and Colours of Light.* In the first edition there were 16 queries. They appear in Newton's text almost as a rhetorical device, they seem thrown in casually, they turn the reader's attention from a series of observations on everyday optical phenomena, and hand the initiative to find out more back to the reader, 'in order to a further search to be made by others'. In the first edition the Queries did not offer any general appraisal of method. In the first Latin edition of 1706, however, this section was much developed, becoming a general essay on method. The methodological observations were carried over and further developed in the second English edition of 1718. RN is here engaging with the 1706 edition, pp. 347ff.. Through succeessive editions the queries increased in number: from sixteen in the first English edition to twenty-three in the first Latin edition, and as many as thirty-one in the second English edition, concluding with the celebrated '31st Query'.

[246] i.e., 'forces' or 'powers', RN's use of the word echoes Newton's terminology in the *Opticks*.

2 Experiments.

That is ~~Expe~~ principles. yes, says he, by experiments,
I ans^{r}, when? ffor If there be No hope by experim'^{ts} to
discerne Into y^{e} texture of Compound body's /on w^{ch} most of those phenons depend\ where is
the analitick? The Instance his followers give, is his
discovers /about\ ~~of~~ light and Colours, w^{ch}, say they, prove
that light consists of Ray's of all Colours, w^{ch} are
white, and Each colour is Qualifyed to be Refrangi=
ble to a different angle, and therefore ~~by~~ Every Re=
fraction separates them into [Rows?], as appears by y^{e}
prismall ~~views~~ /Images\ of all ~~externall~~ luminated objects.
And this colorifick property of y^{e} Ray's are [heterogucall?]
to Each other, and are each subsisting on his on bottom
are derived from y^{e} luminary, & separated by Refraction
and So discerned. However ingenious this is, and an odd
phenomena, yet I do Not see that the Event of a
Refraction, demonstrates the /nature of the light as it was\ ~~light~~ before it. So the Exam=
ple doth Not vouch the p^{r}tension. And after y^{e} Same Man=
ner If folk Should bend their braines for many Succeeding
ages, It would be found Impossible to penetrate Minute=
ness, so as to discover y^{e} Mechanick Efficient's of Com=
plex phenomena, ~~so as to~~ /and\ Enable a clear demonstration
of them, such as cannot be obteined but by Reducing
them to Simplicitys. Therefore, With Reverence & Respect
to what may be discovered, I must Now affirme, that
possibility, & probability, is the farthest of our walk
Into Immensity, and ~~My~~ Minuteness, and who Is Not
content to take y^{e} air so, may pleas to Stay In his No-
science at all at home.

Experiments. ~~3~~.

I doe Not detract from the hon^r of discovery's made
by dioptrick Glasses, w^ch are without very Great & ever
to be celebrated with hon^r to y^e Inventors, & Improvers,
but yet I must Say that all those discovery's are so farr
from giving us hopes of ~~atterning~~ attaining a greater
Naturall knowledg In the way Intimated, that is of Im=
mensity, and minuteness, that they give us great Caus
of despair. the best of them is the Confuting fals Hypo=
theses; as they have done the ptolomaick of y^e world
by Effectuall demonstration. But yet the good Coper=
nicus,[247] without such helps by y^e Strength of his Reason,
Nay Contrary to y^e Evidence of his Eyes, ffound out the
the planetary systeme, w^ch his telescopian Succ^rs did but
prove. But what is the shewing us, the satellites Jovis
Ansa^e Saturni,[248] &c^a. but as a prospective Shew's a lands=
cape more distinct and discovers towers & trees (as y^e other
moon's,) w^ch were not discerned by y^e bare eye. But what
is this to Apenines, Cacasus, or y^e Mountaines In
Ethiopia? our prospectives are Small helps In finding
them out. so what know wee of the, Regio fixarum[249], from
tellescopes, but that It is as worthy of our Speculation, but
/a knowledg\ never to be compast. so the Microscopes that discover y^e
Animalculi, Shew that process also is (pardon y^e Word)
Infinitely defective. And what object is in a Micros=
cope as to the texture more Explicite or Intelligible.
wee distinguish coloured sands, as by plaine vision wee
doe Stones. And Mixtures of coloured Granules or Mettalls
that are Indistinct to y^e Eye, are plainely shewed there
but

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[247] *See* note on f. 94v.

[248] i.e., the moons of Jupiter and the Rings of Saturn discovered by Galileo Galilei (1564-1642) in 1610, although the rings were only properly described by Christiaan Huyghens in 1655. Once again RN esteems the reason and judgment of a natural philosopher (i.e., of Copernicus, thinking against the evidence of his eyes) over the observation and discoveries made by Galileo and others. Heroic though it was, RN thinks of the telescopists as having merely added to natural history, and merely added definition to an already discovered landscape. There is an almost Foucauldian distinction being made here between those who inaugurate discourse, and those who rehearse knowledge within its limit(ation)s.

[249] i.e., the region of the 'fixed stars', the 'World' beyond the solar system.

4. Experiments.

but No More of y^e^ texture of any body, then y^e^ bare Eye Saw,
nor will any more of Smoak, fire, clouds, or any thing In=
deed as to any ~~then~~ porpose of ~~more~~ knowledg more then
is had without them, be found out by them. But they are
Indeed, Great helps towards Naturall history, and w^ch^ is the
cheif use of them, a Most pleasant Enterteinment, as May
be Ingaged In y^e^ Works, of Borellus, Hook, & Malpighius.[250] They
pretend most In anatomy, and divers vessells are seen by
them other wise Indiscernable, and that view of the
hudle of the blood and liquor In y^e^ veines of a transparent
fishes tayle, shewed by the makers if Dioptrick Glasses.
is pleasant beyond any thing of y^e^ kind I Ever saw. But
It would be much More to their praise, If any one cure
In phisick or Surgery were found out by their help, of W^ch^
I know Not any one; but Conceiv most probability of
Good from them In the way of Surgery, where wounds, w^ch^
they say are often, If Not allwais Infested with animal=
culous vermine, as also the [.....?] & purulency's that
come from them, may be actually Inspected, and y^e^ power
& operation of Medicaments upon them.

This may seem as If I did Not Exalt experiment's
and optick Glasses Enough, to w^ch^ I say None more loves
& admires them then I doe, Nor is there any secular
thing I would Choos and with more delight read then
of them. But my designe is to Shew, that the apply=
cation of our minds to Naturall knowledg ought Not
to be

[250] Thus RN dismisses significant contemporaries (Giovanni Alfonso Borelli (1608-79), Robert Hooke (1635-1703) and Marcello Malpighi (1628-94)) as compilers of experiments in natural history, providing 'pleasant enterteinment', and adding to knowledge, rather than as natural philosophers delivering understanding in the largest sense of the term. Robert Hooke, for example, was largely responsible for developing the notion of gravitational attraction. Hooke's prestige had declined before he died, long before this passage was written. Furthermore, Hooke was not a gentleman, and only a technician.

to be abated, or suspended, and all our labours & time
that way be diverted Wholly upon Experiments, without
a previous model, or If you pleas, some Hypothesis to
direct and Enterteine them; w^ch^ is that w^ch^ the analitick
vertuoso, much labour for. And I could better Excuse
them in that, If they did Not precipitate Into Hypo=
theses, & notoriously fals ones, as that of attraction is,
and at y^e^ Same time declaime against them.

1. It is to be observed that Great discovery's have bin
made by y^e^ strength of reason, assisted onely by the ob=
vious experiments of life. I before touched that of Co=
pernicus who following his reason against y^e^ Evidence
of his sight, ~~and so~~ found out y^e^ Earth's motion, &c.
ffor y^e^ planet's at Such unequall distances as they Must
have at oppositions & Conjunctions ~~sometimes~~, ought
to appear with unequall light & magnitude accor=
dingly, but for all that /to y^e^ Eye\ they seem allwais of the Same
magnitude; yet he Concluded there must be Some other
caus for that, tho he knew it Not, and would Not Quitt
his reason So violent & In so vast [Consequene?], ffor a
a scruple of sight. Nor did he Ever live to see his
thought confirmed by Glasses, w^ch^ taking off y^e^ watery Re=
fraction's of y^e^ Eye, shewed y^e^ planet's light /& Magnitude\ In pro=
portion to distance; This Invention was but Confirmed
by Glasses, w^ch^ might If sooner found out, sooner
have made y^e^ discovery. and who can tell but this
wonderfull discovery of Copernicus, stirred up a Spirit
in Succeeding time, such as moved Gallileo & others

6. Experiments

to rack their Invention's ffor means' to demonstrate
what they thought true, but Could Not Evince to others
ag^{t} the power of their p^{r}judice, and thereupon fall
Into y^{e} Invention and use of Glasses? whereby the disco=
very was y^{e} Caus of the Experiment that followed af=
ter to prove it.

It is observed of Cartesius, whose caracter I will Not
give being a supposed partizan, but Referr for that
to the wonderfull good & Great D^{r} Barrow, In a
speech printed in his [wor~~th~~ks?]. 4. vol.[251] that he In the Shew=
ing his method, principles, & whole hypothesis, useth
no Experiment, but what is Obvious and Every one knows,
such as Recess from the Center of turning body's, & y^{e} like.
But yet it appear's he wanted some Experiments and
trusted too Much to his reason without them, and that
is In y^{e} Rules of motion, ffor altho he by his reason from
comon observation, he found motion was Regulated
so that when one body Struck another, y^{e} Event of
y^{e} Movem^{t} after it, was certein; yet he missed of his
Guess in the proportion's, w^{ch} an attendance upon some
Experiments, might have ~~bin~~ regulated. or It May
be, If he had bent himself more to Reflect, he Might
have come neerer the truth, by force of his reason. But
Even this Instance shew's, that reason ledd to that Im=
portant truth, and then Experiment Refined and
approved it.

These thing's I alledg ag^{t} those, who are hunters
onely of phenomena, and decline hypotheses,
suspending

[251] Isaac Barrow's *Lectiones opticae et geometricae*, were first published in London in 1669. Presumably RN is referring here to the same discussion as that he mentions at 159r, above. RN therefore seeks a 'caracter' of Descartes from one of his opponents, which is a clever manipulation of witnesses by a skilled advocate.

Suspending all application to Efficient Causes, Expec=
ting also out of a mature collection at length, to
Receiv ye opime fruits, in an adult body of truth all
at once. Wch If Copernicus & Cartesius had done, perhaps
nothing by them discovered & advanced had bin yet
or Ever knowne. and Such proceeding Quenches Curiosity,
and Suppresseth Invention; ffor that Grows accidentally
as Mens reason, & Genius, meets with conjunctures to
Give a start or hint to thincking. And one Man's Ex=
travagant flight, or Guess, may be to another an
hint of solid truth, wch had never come in his Mind
without such advantage or occasion. therefore he that
proposeth to Collect all ye vires attractiones, he men=
tion's, and allso supposeth, wch are Not a few, and then
begin to thinck of the efficient caus of attraction,
Never mean's to begin. And I would willingly have
Some Instrument made, whereby one might weigh
attraction's, and know wch are by pulsion, & wch by ye
vis Insita;[252] for without some extraordinary Scales I
doubdt it will Never be revealed. And In ye Meantime
as to his process, wee thanck him for Nothing, ffor who
will not say thing's attract one and other, it is ye Com=
mon language of ye vulgar, who w use words when
they want things, to fill up their frothy discourses
as they allwais are in matters phisicall. ffor those
Require an habit of considering abstractedly, and
of Expressing cautiously what they so thinck, or els
Even they themselves would Scarce understand one
& other.

[252] i.e., 'inertia'.

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8 Experiments.

To Conclude this matter, Experiment is as much the
application of y^e^ observer, as the materiall set at work;
ffor accidents shall happen In view, w^ch^ a Curioso will
Note, and apply philosofically, with great use In his
Cours of Science. As to Instance, I onely touch those
of y^e^ waves on y^e^ surface of water, The high rope of
the builders Engin, the cart rope on y^e^ Ground, & some
others Mentioned in these papers, w^ch^ Introduce thoughts
y^t^ lead to a clear hypothesis of fluids, and that won=
derfull one of y^e^ air, with its Gravity and spring.[253] I am
certein the Most Elaborate Instituted Experiments, that
have Ever bin knowne, cannot let in more science
then those, and withall how Comon and litle observed
are they? whereby one would thinck, the observation
makes y^e^ Experiment, and not this, that. It is possible
that when a pointe is Experimented, that is from ob=
servation of Event's thought of, It is a good Guide
ffor other's to Institute Experiments by, ffor prooving
y^e^ truth, and more especially y^e^ gage or Measure of
it. there being a vast difference between y^e^ discovery
or Notion, and the Mechanicall knowledg of it the
former is content with y^e^ Gross, but the Mechanick Must
be Sure of y^e^ weight's and Measure's of it; and therefore
men of mechanick Genius are allwais making proofs,
and With Good ~~Reason~~ Reason; ffor our thoughts are In=
certein, full of oversight's, and tryall's Regulate Even
Them, and ~~by~~ /thro\ failing's /appearing\ readyly supplyed, obtein the
ends they aim at.

---

[253] All these examples, examples drawn from from RN's *experience* (a cognate word to experiment, of course), which could be *anyone's* experience, appear and reappear in RN's MSS. He draws attention to how Descartes drew from everyday experience, and how that was commended by Isaac Barrow. The most famous arguments from quotidian experience come from folk lore, wisdom literature and most famously the parables of Christ. RN is making a plea for a kind of plain style in thinking and argument, as well as criticising the overdetermination of results that comes from poor experimental method, and the shallowness of inductive, badly reasoned hypotheses.

Experiments. ~~9~~.

I would Gladly suggest some hints towards abridging
this Infinite process of Experiments; and ffirst I propose
to direct them, to the proving or disproving, opinions
that have bin already vented, whither disputed or Not;
As If it might be, to shew If any Space Can be perfec=
tly Empty, or If all Spaces are allwais ffull. And so for
The New (or Revived) principle of attraction, whither it
be a Quality Inherent that bring's things together, or
some comon caus that direct's /divers\ body's towards y^{e} Same
place. And as to that I Conceipt there May be an Expe=
riment, to Confute y^{e} fancy of universall attraction In
body, w^{ch} makes it approach, Every part of y^{e} other, ac=
cording to It's density, y^{t} is Substance.

The author of y^{e} principia, aware, that it might be as=
ked Why stones, and wood ordinarily did Not attract each
other, and so cohere upon y^{e} Earth's surface, of w^{ch} there
is No signe; alledgeth that y^{e} attraction of y^{e} body of y^{e} Earth
that is Gravity, is so Much stronger, that those litle attrac=
tion's are overcome, & therefore appear Not. Now it seems
possible to take off y^{e} force of Gravity, as body's swimming
upon water are poysed as to Gravity, and it hath No Effect
upon them; why Should Not therefore Shipps & boats, Come=
together, & stick close? It will be answered that y^{e} body
of water is all round, & draws as well y^{e} Shipps and that
hath So litel force among y^{e} Rest, that It Suffiseth Not
to Conquer the Impediment of the Medium. then it is
to be Considered If that Can be Removed.

let

10 Experiments.

lett body's be p[r]pared of vast Magnitude & weight, w[ch] to
us, is an Indication of compact Substance; ffor It is proved y[t]
the Resistance or Impediment to motion of y[e] Medium
is less to greater then to smaller body's In vast disproportion.
So that take y[e] air for y[e] medium, and such Great body's
in it, there is litle or No account to be made of y[e] Impedim'[t].
And then for taking off y[e] effect of Gravity, let them body's
be Suspended by cords of a vast length, as to y[e] summitt of
a tower on y[e] Inside, so y[t] y[e] tension of y[e] Cord May be
Strong, & take y[e] Resistance of y[e] air from that, and y[e] bodys
Swing with an Intire radius. Here an arch of, 1^0. or 1^1. and
perhaps. 1^{11}. may on such radius be discernable; and how
ever a swing In a small arch raiseth y[e] body In y[e] perpen=
dicular very litle, & here, May be Next to Nothing. So that
Gravity hindring No Motion but In y[e] perpendicular, Is E=
nervated. Then it may be seen, If these pendulous body's Will
Cohere; ffor Nothing hinders, and they may be made in What
proportion wee will.

This Manner of Experiment will also prove the rules of
motion. ffor whereas Even Cartesius, & Newton, as well as
pardies, not to be named with them, hold a great difference
of Motion, In vacuo, & In medio Resistente.[254] all w[ch] I thinck
a meer concept, & without Ground, & here it may be proved.
as for Instance, Newton say's, body's y[t] meet in vacuo will
not part; I deny it; he Say's, it is springyness In body's y[t]
makes 'em separate, I deny that too: let this experim[t]
be y[e] probation, In w[ch] Gravity, and y[e] Resistance of y[e] Medium
are litle or Nothing, and they may use lead with flatt sides
y[e] hath No spring.

[254] i.e., 'in a vacuum, and in a resistant medium'.

185r

Continuity 1.

Cartesius Suffers for his Manner of Expressing his
Thought's In this Question of Continuity. and the
Matter it self, hath also suffered, ffor Mons^{r} le Clerk
Say's it is Indeterminable, and y^{e} Question ever Re=
turns. ffor he with the Rest deride what Cartesius
say's, that body's are united by Rest, as with Glew,
w^{ch} is by, /~~.~~?\ meer Nothing. and the Hamists,[255] who say
things by their asperity's & Hooking clasp together,
are answered by y^{e} Question, w^{ch} Ever Returnes, what
Holds the prominent ~~part~~ and Hamous part's ~~of~~
together. As to perfect Rest, I cannot Imagin what
Cartesius meant, ffor he is dead & cannot ans^{r}, and
I beleev he had somewhat in his mind More reasonable
If he had ~~h~~Happened to Express it, unless it be this. that
If two body's touch & Rest together, a moment, there
is no difference but those are as much one, as the
part's of /any\ one and the same /single or unporous body\ are. so he made it a prin=
ciple of continuity, that parts once Resting Contiguous
became one. And it is necessary to suppose some prin=
ciple or other to Reconcile this difficulty. ffor that
there is somewhat w^{ch} makes a continuity or Cohe=
Sion ~~In~~ of y^{e} Component parts of Comon obdurate
body's is certein; ffor otherwise, It were Necessary y^{t}
all y^{e} world were as powder Impalpable, or fluid,
w^{ch} wee know full well is Not so, but how, or In What
manner This componency is wrought, Mons^{r} le clerk,
dispaired of Ever knowing, and therefore took an
easy cours of throwing away y^{e} Question as unSolvable
and laught[256] at those who went about it.

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[255] i.e., those who believe that matter is held together by hooks (Latin: '*hamus*'='hook').

[256] I read this as 'laught', since that accords with RN's comment below (f.189v) that we risk Le Clerc's 'derision' if we inquire into continuity. (For Jean le Clerc, see note on f. 6r above.)

185v

2. Continuity

As to this matter I have to propose, first that Com=
pound body's, are made up of others subcompound
ad Infinitum; And herein I make use of the suppo=
sition of actuall Infinity, as well as before, In ye Case
of motion, for plenitude.[257] but to ye Matter, there is
Nothing great wee handle, but contused, breaks in
other like In lesser formes, and where is the stop?
A larg stone is Compound of pebbles, & Gravell, petri[=?]
fyed together, those pebbles sometimes appear Com[=?]
pound of others in like manner, and Microscopes
perhaps will Shew you a degree or two farther bu[t?]
No End. And In many thing's the hamousness of ye
parts, so farr as they are visible is apparent Enough
Then as to ye ansr, demanding farther what holds
those hook's together, It may be Returned the ham[o=?]
sity of smaller parts, and So subhamosity's hold Ea[ch?]
other together In Infinitum, the Sume or agregate
of all wch, ~~may appear~~ /are to our sence\ Indistinguishable, as In a
lump wee hande. This cannot be Confuted, ffor Whe[re?]
is the Escape? There are hamous parts smaller the[n?]
any others assignable, wch is No More an evasion he[re?]
then the like /discours\ used by mathematitions. All wch may
be sufficient to Refill ye Caption of ye Question's Returne[d?]
But, Is Confes't to want ~~a~~ positive argument And
as to that.

Since it is, as I hinted, Necessary to use a principle
mine is this, and I thinck No new one, [esst.?] that the
matter of ye world, ~~is~~ taken in the primary parts, or
Devision's of it, is not onely Extended but adamantin[e?]
or, In

[257] Here evidence of an intended arrangement - the essay on Continuity followed the essay on Motion.

186r

Continuity ~~3~~

In y^e^ phrase of D^r^. More,[258] Indescerpable, or Not by
any practick force alterable. And that all the /seeming\ frac=
tures and Contusion's of matter wee know, amount
but to separation of part's, and Not alteration of
their Quantity's or figure. As to y^e^ Magnitude of these
primary part's, as well as their formes, & shapes,
wee can determine Nothing positive, but Confor=
mably to the sensible world, may conclude them
to be various and Multifarious, ffor there is litle
If any geometrick regularity In Nature. As to y^e^
Magnitude, ~~It may be~~ the greatest may possibly
be less then any thing wee Can discerne, as 1/8000.
or other Inconceivable proportion. If any be larger
then other, they are towards y^e^ Regions of the fixed
Starr's and Not neer the centers of any Etheriall
Movement.[259] Now If this hypothesis be admitted it is
Not hard to Imagine, Especially aided with those
Impediments of movem'^t^, touched In the chapter of
plenitude, how these differme, unequall, Irregular
part's of matter huddled together, May Conglomerate
Into lumps, such as wee handle & see, whereof y^e^
manner must be left to Imagination.

Then for argument, touching y^e^ probability of
this Hypothesis, I say that Impenetrability, & Exquisite
hardness are almost one & y^e^ Same Notion. our Idea
of fluids, waxe, & other yeilding thing's, cannot be
transferred from our braines to the primary part's
of matter. ffor those are all Compounds, and have
notorious

---

[258] Henry More (1614-87), philosopher, leader of the Cambridge Platonists and, in the middle of the century, the principle defender of Cartesian ideas in England. RN refers to More's use of the word to describe the indivisibility (of the 'material') of the soul in *The immortality of the soul, so farre forth as it is demonstrable from the knowledge of nature and the light of reason*, London, 1659.

[259] i.e., the movement of the ether, the driving force of RN's and Descartes' vortex-like planetary systems. RN believed that the smallest and lightest elements moved to the middle of the vortexes, and that the largest and heaviest were spun (by centrifugal force) to the perimeter.

notorious distinction of parts, w^ch^ yeild one before another
but Where No such Separation is, where Shall it begin[??]
That y^e^ Mass is hard, or Impenetrable, every one
admitts; for It will Not be Compressed, then why
Broken? If it be say'd a Sufficient force will break
any thing, I ans^r^, what bounds that force. or why is
there degrees In hardness, when all are Equally Im=
penetrable? If one say's any force, I may as well say
Every force, and then there Can be No continuum.
But If wee admitt primary part's without pore, or
seam, It Seem's Impossible to devide it. the Idea wee
have of Contusion is this. 3. Globules in triangle A.B.
<diagram> &. C. If Either be driven towards y^e^ other, that
putts them away, w^ch^ is y^e^ Case of ordinary Contu=
sion; when one thing is driven away by another. but
<diagram> suppose y^e^ triangle A.B.C. of a matter Infinitely
Resisting penetration; And to have No part or
seam in one place more then another, it is
most reasonable to say No force at A. can drive
asunder y^e^ parts B. &. C. this Nor that part Can=
not give way, for it is Equall in all Respects, w^ch^,
and determined to None; If it must Crush It must
be into parts of No magnitude for Nothing is /there\ to de=
termine of what magnitude any part's shall ~~be~~,
after such Crushing, Carry? This subtilety /of discours\ is onely
to shew the more probable opinion, & that I Stick
to that matter, or primary Corpuscles, are Not
alterable by any practick force, but Remaine Ex=
tended, figurative & Indiscerpable for Ever.

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Continuity. 5.

Now pʳsuming yᵗ body is adamantine & unalterable
and of multifarious magnitudes, & figures /and of such yᵉ world Compleatly full\ It may be
Considered how many accidents will Concurr, to Make
frequent cohesions of matter such as we perceiv In yᵉ
forme of Continued body's. Wᶜʰ May Ranged In five
classes. 1. figure, 2. Rest. 3. want of Gravity. ~~4. plain touch.~~ and. 4. plenitude of yᵉ world.[260]

1 ffigure. ffor when divers Magnitudes of divers formes
Some long, Some broad, some Ragged, other's squar, ovall
Angular Round &c. come together, tho there may Not be
direct hooks upon them yet, they may cluster together,
and yᵉ prominences Interfering & Hollow's Receiving, It
may be Sufficient to hinder yᵉ minute agitation of them,
and Consequently the separation.

2. Rest. or plain touch, as the figures may be. ffor
If Cubes are compact together, touching by their sides,
It is Not Easy to part them; ffor wee Seldome can ap=
ply an Instrument, unless it be fire, or Menstruums,
Wᶜʰ Insinuate among yᵉ parts, Subtle enough to digg
any out, and what Signifyes yᵉ brushing a few off at
yᵉ Corners? I doe Not Insist on cohesion by touch, tho
I cannot, as I sayd, distinguish between, a body apart
and Joyned with another by a flatt touch, wᶜʰ is perfect
by closing, without pore or Intermission. If that Should
unite body's, there would grow Such union's often, &
might tend to aggrandise matter; But Whither so
or Not, wee must Consider it seldome happens, but
comonly.

[260] RN states there are 5 classes, but lists (and describes, as we read below) only 4.

6. Continuity

comonly Matter falling together and apt to close,
as the shooting of salts, have some smaller Stuff be=
tween, y^t^ makes a bed, or some Granules, y^t^ are Suf=
ficient to p^r^vent a perfect touch, so that such are
held together purely by the masonry of their figure,
As bricks heaped In y^t^ manner, are Not Easily by one
Gross protrusion separated.

3. Want of Gravity. that w^ch^ makes Great things fall
In peices, is their weight, for many lumps of wall &
Rubbish would cleav together, If there were Not, a
weight w^ch^ make's them strike & be Resisted, & so
broken. And If one asks why, a body held up, y^e^ parts y^t^
compose it, being closed onely by their forme, as I
Instanced In cubes, I answer becaus, Small body's are
disabled of all y^e^ power & effect of Gravity. This is proved
by drops of water, w^ch^ Small suspend In clouds, but running
together fall downe, In Rain. And y^e^ demonstration is
that as Quantity deminisheth, so superficies In pro=
portion Increaseth. as. a Dye. is. Cube. 1. and Super=
ficies. 6. the Next Cube is. Dyce. 8. and those have su=
perfeces. 24. vist. 6 x 4. = 24. less superficies to y^e^ Sub=
stance by half, then y^e^ 1. Dye Had. And Resistance of
falling is by y^e^ Superficies, & y^e^ force by y^e^ Substance, so
y^e^ air, being a stated Resistance, deminution bring's body's
to be wholy Impeded from faling, & consequently, [thes?]
all would fall together, yet one part would Not
fall from another.

4. And lastly plenitude, conduceth much to the holding
things

things together; ffor altho It be Not an hindrance of
motion, it is an Incumbrance, or Impediment to some
as was touched before; ffor If body's do Either Not
readily part, or cannot be parted att all but In a
certein manner, w^ch^ is the Case of flatt thing's, No
wonder that /an\ obstruction /of y^e^ parts\ to y^e^ yeilding to Every
force, hinder's y^e^ Effect, of many forces, from Sepa=
rating them; Especially when wrapt up together In
clusters.

All these things Considered, and also that, there
is weight that presseth together the part's of y^e^ Earth
and things doe not Readily move but In channells
& Interstices, that Since few forces, except fire, &
menstruums (w^ch^ have Effect Enough to macerate
Continued bodys) are proper to decide them, but
Instead of separating y^e^ parts, drive all away to=
gether In y^e^ Same heaps it finds them. wee May
well allow the Clustring of matter is knotts about
Surfaces, & within y^e^ compass of y^e^ planetts; And it
is also to be considered, that ConGlomerate bodys
May have divers Graduation's, It is hard to Say any
thing less then Infinite, before they are Sensible to us,
as some may be formed, Into springy, flexible, obdu=
rate, & y^e^ like parts, w^ch^ may yet be component of others,
and If an analisis Could be made wee Should find
them as Cartesius hath attempted, Most Ingeniously
of water, & thereby Resolving Rarefaction, & Con=
densation; but If Such parts are they are Conglo
merate, of

8. continuity

of others, thro Many degrees, as other's, more visible.,
are Among us:

The Case of 2. flatt marbles polish't, w^ch^ are very dif[=?]
ficult to separate, doth Not wholly depend on this
deffect, that is y^e^ passage of y^e^ Interstitiall supply from y^e^
Sides to y^e^ midle, but In [some?] measure it doth. ffor tho
A Matter may come thro y^e^ pores, yet many Small flatts
as small as y^e^ pores, may cohere for like reason as hath
bin Expressed. But the Gross caus, is y^e^ presure of the
Air for that Cannot goe the pores; but must Enter by
y^e^ Sides, so that If a parting be paralell, there must
certeinly be a Torricellian vacuity,[261] w^ch^ loads y^e^ Mar=
bles, & holds them together, So y^t^ If not very /larg &\ heavy, y^e^ one
will suspend y^e^ other.

S^r^. Is. N. would screw this circumstance, to prove attrac[=?]
tion of body, ~~but~~ and alledgeth, that Marbles will co=
here In y^e^ Exhausted Receiver, (for y^e^ pump will Not Neer
Exhaust all.)[262] however it may be for the reason befor[e?]
given. And doth In No Sort argue attraction. ffor If
~~It did~~ ~~d~~body's did, as he contends, attract Each other,
It would be seen by Contact upon points, as If a marble
Instead of polishin were creased, as a milstone, they
would Cohere, W^ch^ they Will Not In y^e^ least degree.

Wee disagree here with Cartesius, who supposeth the
subtile matter worne downe by motion Into Globule's
ffor that is alteration of primary parts Not allowed
by us. Nor doe wee /care to\ conclude /ought\ from any circumstance
of y^e^ Insensible subtile matter, nicely & particularly,
supposed; becaus it may as easily be dissupposed by ~~who please~~
whom it pleaseth so to doe.

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[261] RN refers to 'Torricellian vacuum/vacuity' when discussing actual vacuum, since he accepts the possibility of a manufactured vacuum, and the conditions in nature where something similar might momentarily occur, as in an explosion, but he does not accept the existence of vacuum in nature, following the traditional dogma that 'nature abhors a vacuum'.

[262] The 'Exhausted Receiver' (referred to several times in the MSS) is that part of the apparatus of an air pump which has been drained of air, i.e., the bottle 'containing' the artificial vacuum.

189r

Continuity[263] 1

Considering what a thinker cartesius was, I have often
wondered what was In his mind when he sayd that bodys
~~perft~~ perfectly at rest together, cohered as with the
Strongest Glew. He is dead and Cannot answer for him=
self, tho there is need enough, ffor there is Nothing In his
works for w^ch^ he is more Slighted then that. And I have
beleeved there was some what more in his mind then that
but perhaps it was not digested to his Content, & ~~h~~He did
Not thinck ffitt to say more, and In truth he might as
well have sayd Nothing, or /Els\ he did Not understand the
Cohesion of bodys; But it is possible he might Consider
body or matter to Consist of simple or unporous parts, w^ch^
were all /of\ one Even substance, having Nothing to devide
or distinguish any marks of Subdevision In them. Now If
it Should ffall out that two such part's should touch each
other by Superficies Exquisitely flatt, y^e^ witt of man
Could Not ~~distuing~~ distinguish y^e^ unity of those 2. parts,
ffrom y^e^ unity of the part's of any one of them. and
whatsoever it was that held a single part together,
and wee could know nothing there to doe it besides Rest;
why then Should Not rest hold together, that is make one,
two part's that accidentally touch? And so farr is Sure,
that two body's So Resting, are y^e^ Same as any one
as to unity.

But this is Not Satisfactory, ffor it is Not made out
that rest is any means to hold thing's together, nor
is any other mean's Shewed; that of Hamosity's will
not

[263] The following section (up to f. 196r) is paper that has been subsequently marked, both by the white chalky efflorescence noted elsewhere (see f. 12v, etc., a section which essay was certainly composed during the same period as this one), and by darkening owing to dust (notably ff. 193-4).

not serve the turne, for ye Question Ever Returnes, what holds together those Hames? for this Reason le Clerck defy's ye subject, and say's it is a matter irresolvable, & it is a weakness to undertake it. This is an Expedite method to get ridd of a Question. But Considering wee have the subject continually under our feeling, and doe discerne all of ye degrees of contenacity, from ye diamant to meer water or air, It is Not In our power Not to be Inquisitive after the Nature of this so ordinary conglomerations of Matter. Therefore with Mons le clerck's leav, and suspension of his derision,[264] wee will turne ye Subject a litle, and See If wee can find any dawning's of reason ffor this so Comon a phaenomenon.

1. And for this Reason I will first propose, that to say Hamosity's, protruberences, Cavity's, or Inequality's may be a mean's to hold things together, is Not so redicolous opinion, as the Dutch phisicus make it.[265] ffor Having taken ye freedome to setle matter In actuall Infinity of Smallness; let the Question Returne, the ansr is at hand, as what holds the Greater clasps on? I ansr lesser, and sic ad Infinitum. as ye Mathematitian's argue all the Infinity's they deal with. and this subhamosity to Infinite, may arise in ye aggregate to sensible lumps, as A progression of Infinite lines, makes a formed Superficies. This cannot be confuted, No more then other cases of geometrick Infinity, for I say, as they In like occasions, Hamosity's, less then any hamosity assignable. But

I doe

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[264] *See* above, f. 185r.

[265] I have not yet identified this reference.

Continuity. ~~3~~

I doe Not Rely on this, becaus it is a reason Not very
Explicite, or plausible, and looks like an Evasion rather
then argument, therefore I look out for better.

And In doing that I must of Necessity state some clear
Notion by w^ch^ wee comprehend the thing wee call Matter
or body. And as to that, It is already Supposed Impenetra=
trable, and wee know No other universall Quality It hath.
Then, that it is devided Into parts; And In generall wee
must take them Either as simple without pore, or Els /as many\ Con=
Glomerate, or Compound /together\ ~~of many.~~ the latter of these onely
ffall in our Notice, ffor the simple part's are so farr from
being knowne, that wee cannot demonstrate there are any
such; ffor it may as well be affirmed, they are Compound ad
Infinitum; onely by our observation of things wee find much
Inequality and Irregularity, and from thence, I thinck, there
is reason to conclude y^e^ compounds In some measure Shew
the nature of y^e^ Components; and whenever wee make a
Judgm^t^ of things Insensible, wee must make our aime
according to What is sensible. And thence I gather and
Conclude that body Consists of devided parts, of all
Magnitudes (under a certein demension, w^ch^ is yet less
then wee have hopes to discerne, tho y^e^ greatest of them,)
And of shapes altogether Irregular, like other things in
y^e^ world, In w^ch^ ~~cast~~ scarce any Geometrick Exactness is
ffound, but ffall more or less ever as wee Say accidentally.
So that I cannot assigne the Globular ~~cupa~~ cubick, pira=
midall fforme to originall matter, but all fformes; but

yet

4. Continuity

But yet it is reason to thinck that as Graines of Sand
or stones on a beach they are distinguishable Into classes
As some may be Inclining to y^e^ Globular, other's to the
Cubick, or paralellipipedous, others to other denominate
formes, and so also mixt of divers, tho Exactly of None.

Here I leav Cartesius In two thing's. 1. that he Supposeth
the Etheriall world composed of Globules, and as he des=
cribes them neer Equall. ffor what familiar had he
to Make him a confident of the state of that Small Ma=
teriall? Then. 2. In Supposing the Globules Might possi=
bly by action have bin worne into y^t^ forme, by action w^ch^
hath rubbed off their corner's, and those corners made use
of to fill y^e^ Interstices. ffor besides the secrecy of y^e^ buissness,
w^ch^ checks any ones p^r^sumption to Guess concerning it, I must
be of opinion that the simple part's of Matter are ada=
mantine, that is Exquisitely hard, and Capable of No
fracture, Flexure, or Impression. My reason is. 1. that Im=
penetrability and Such hardness seem one & y^e^ Same thing.
besides what fforce is adequate? If any force Shall break
or bruis a part, then Nothing Could be hard; If Every force
may Not, but Some force may, what hath determined that[??]
It is easyer to say No force can doe it, then to Imagine a
frangibility to Some degree, but wee know Not what. So [.?]
that untill wee find a principle /to\ fix a frangibility between
the Extreams, of being subject to all or None, and Since
y^e^ former Cannot be, wee may reasonably Conclude y^e^
latter

latter; The rather becaus the Experience of things leans
that way, and altho Compound body's are so often discer=
pable, there seem's somewhat hard, beyond Separation of
parts, that may not be crusht. but This case will not
fall under Experience, becaus wee have Not faculty's to
penetrate the Recesses of smallness, to know Certeinly any
thing of it. but of this I will be Confident, that the sup=
posed adamantine Nature of body, is In no Sort opposite
to any phaenomenon of Nature. And as for those who
will take ~~all~~ the liberty to Say, matter is ~~ab~~ capable of
all degrees of strength, and crushable some with more
& other with less force, & others, perhaps, Indiscerpable
by any; I cannot Confute them, but choos to accept the
State of Matter ye other way,and for ye Reason's Given. To
wch I may to Conclude one, wch is that It is Indetermined
where a fracture shall begin, & then there can be None,
ffor If a cube be forc't by one side and stopt by another,
wch of ye other 4. sides shall Give way first? Nay Supposing
No pores, what direction is there to thro any side outwards,
So It Seems ye force must crush it Into Nothing, or Not at all.
But waiving this dispute, It will be Conceded that wee know
No force can break a part unporous; ffor what Engin shall
hold, and how Shall ye force be applyed? And all sensible
fractures are but dislocation's and no one Can affirme
any one of them wee know doe violence to any primary
part of matter. Therefore waiving all farther dispute /whither adamantine or Not\
wee Rely on this, yt matter hath an hardness, wch No knowne
force can violate. This is that Dr. More Calls Indiscerpability

And from hence it follows that Elater or Springyness is
no property of body, being a phenomenon of Com=
pounds in a certein manner, as may be shewed afterwards
and Not of Simple parts. ffor If such a part yeilds to a
stroke so as y^e forme is altered, and from a circle it
becomes an ovall, I desire to Know what power should
Reduce that back contrary to y^e force y^t beat it? they
will say, an Internall principle. Gratis dictum. But
consider In this chang of the figure, the position of Infinite
parts, that is of y^e whole mass is changed, that is devided
one part from another, what should Joyne them together
againe? If all y^e body is not changed so, but where the
force falls, there it sinks in a litle, & Results, that is a plain
penetration of substance, whereby y^e matter is forc't Into less
Space then it filled before. And so for y^e Result, I suppose
they say it fly's out as Spring's allwais doe, then y^e body
Is Greater, filling a greater figure then before. Those who
will maintaine such thing's may as well maintaine,
that If a body /be\ forc't one way, it Shall come back of it self,
or ought Els, they shall pleas to dogmatize, where Expe=
riment & demonstration will not reach to Confute them.
But there is a sort of Cander, and moreover it is a
tacite $agreem^t$ that takes place among vertuosi of honner
Not to Chiccane & wrangle, but leav that to y^e Scepticks
But to allow, or at least Not contradict, what is reason=
ably supposed of things abstruce, where No clear/er\ Evidence
can be given, not better expedients for y^e porpose be Suggested.

Continuity. ~~7~~

Now taking originall Matter in y^e^ State & condition here
Rep^r^sented, let us see If wee may discover any Conjunctures /such\
as from accidentall concours of things may happen to occa=
sion Matter to Conglomerate together as see see it doth.

In y^e^ first place It is to be observed that, the lumps of Con=
Glomerate matter, are Resident neer the centers of Row=
ling movements and are such as they call heavy, w^ch^ croud
close together & press Each other. Wee know not any such
lumps at any distance from y^e^ planet's, except comets
w^ch^ are a peculiar sort, & litle understood: hence the
crouding thing's together by gravity conduceth somewhat
to continuity, and that is by obstructing movements, where=
by other mean's of cohesion may take place.

That w^ch^, In our Imagination makes cohesion of parts
seem difficult, is the state of Gross body's, w^ch^ being loos
will not setle together, but If Joyned Even by cement
will on y^e^ least stirring often part, so wee argue from thence
the like loosness of small things; but there is Not y^e^ Same
reason. and much less cohesive caus, shall hold small
thing's, for y^e^ proportion, together then great. for of y^e^ latter
every price hath a distinct Gravity and distract's it, but
of the other the Gravity hath Effect upon y^e^ aggregate
and Not upon single part's; as larg drops shall fall in
Rain and smaller be suspended in clouds; y^e^ reason
whereof is demostrated Elswhere, and is In Short this,
that force is according to substance, and Impediment
according to superfices, and Great body's have vastly
more force that is Quantity, for y^e^ proportion of Impedim^t^
y^t^ is

that is superficies then Small ones. therefore you May
possibly take up a lump, and the part's have No princi=
ple of actuall cohesion, (besides such as I may touch
upon) and the Small parts Shall not fall from one and
other by y^{e} force of Gravity, as If you took up a brick
hous, by y^{e} turret, one thing Should dropp away from a=
nother, till it ffell all to peices.

So likewise friction. w^{ch} is an Impediment of motion, hath
more power of small things, then of great; for the reason
Shewed. and thing's so small as the primary part's of Mat[=?]
ter, are wholly subject to that Impedim'^{t}, so that the per=
severence of their fforce, is nothing ag^{t} it, so small is y^{e} ration
on y^{e} Side of Quantity[,?] to that of y^{e} Superficies. ~~so~~ /W\hereby Comon
Shaking or tossing will not make thing's that touch slip
by one & other so as to make a generall parting, and It
Must be a great Concusion that makes any of them give
way, as when a thing is throwne from a loft ag^{t} y^{e} Ground,
y^{e} Sudden Stop make's it Scatter in Great measure. and this
reason may be alledged, for some degrees of continuity,
that is when lumps are easily broken.

Another Consideration is, that y^{e} outward part's defend
y^{e} Inner from violence, and If wee should admitt that there
were no cohesion at all, and any force would brush off
from y^{e} outsides matter Continually, and so more, as by
y^{e} Removing of some, other's are Exposed, and ~~at~~ in time
wear y^{e} whole substance away[,?] but wee having but Gross
member's cannot come at any Interior parts, Nor y^{e} Ex=
terior ~~by~~ /but\ by broad spaces, & not by point's, to Insinuate

under any of ye small component parts; And No
wonder, that when wee croud Such lumps afore us
and they fall not apeices. whereas If some materiall
wherewith, as small thing's can Insinuate among small
tho Great cannot among small things, The part's may
be heaved up one by one, the most seeming hard body
is Instantly reduced to powder, as wee by ye Effect of
Aqua fortis upon Iron, whose force Exceeds that of a
[-bout-hammer?] as they call it, becaus it operates Mi=
nutatim,[266] & not Grossly. let us borrow of ye Imagina=
tion a litle help in this matter. as for Example,
let a pile of squared brick, as Bigg as ye Mountaine
Snowden, or If need be. 1000, times as Great; ffor
as to Number of part's a cubick Inch, maybe prsumed
& reasonably to exceed even /ye bricke in\ that. And let these bricks
be supposed to be void of all (Effectuall) Gravity; that
is to weigh in ye lump, but ye Minute parts not of them=
selves dropp off, wch is ye case of thing's very Minute.
and a Giant of Competent Magnitude, took up this
lump of brick in his hand, and pressed it with his
Gross fingers, and perhaps drove away many 1000ds
towards corner's & edges, & It may be some damage
to ye Sides also with that Rough handling. would Not
this Mighty man have an Idea of continuity of body's
~~as w~~ from the observation of that, as wee have of others,
wch considering with allowance of proportion, are In the
very same Circumstances? It seem's he would, therefore
ordinary Continuity is Not such a Miracle, as Some Make it.

[266] i.e., 'little by little'

193v

10. Continuity

And ye fault is, In Not Collating measures of thing's, wch in
such vast disproportion, between our ~~mems~~ members, or
any Instrument's wee can use, Except fire & Menstruums,
and ye component part's of body's not agitated With In=
testine motion, May well produce, that seeming un=
accountable phenomena of Continuity.

Then it must be observed that the figures of minute parts
May be Such as conduce to things cohering; and here wee
may suppose great Irregularity, If Not some sort of ha=
mosity's; ffor granting ye part's of matter without pore to be
Adamantine, there needs no caus to be asigned why ye
part's even of them cohere, becaus they are one In their
Nature. Then as parts may fall together Some larg, others
Smaller, some long other's short, crooked, excavated, &
Gibbous, & what not? as ye variety of things Invite us
to Imagine; It is Not Strang if they Conglomerate In
lumps & are Not seperated, without minute applica=
tions wch are a match in litleness for them; as aquafor=
tis & fire. And it seem's by how much the mixture of things
is more perfect, ye Continuity is Stronger; as stones sand
& mettalls, from /divers\ ~~one~~, run Into ~~divers~~ one Mass; & that
by Shaking them together by fire, wch Removed they set=
tle together, as one may almost discerne In ye Cooling of
Mettalls, by ye Naked Eye; And all this while it Must be
Remembered that ye minute part's have No Effectuall
or motive Gravity, wch occasions us, yt observe onely
Great things In wch It is effectuall, to Conceiv so Much
difficulty In the Subject of Continuity.

Continuity. ~~11~~.

But then It is to be Conceived, that as a winower of
Corn Sifting the Graine, shakes y^e Chaff one way and y^e
corne another, so In y^e hudle of minute thing's agitated
with Motion, & perhaps fire, doe gather Into $sortm^{ts}$
of magnitude & figure, that hath Some mean's of hol=
ding to Each other; As those towards y^e Globular figure
doe Not clott together so much as part's of other figures
that more obstruct Each other's $Movem^{ts}$. and things
Square and cubick, or as paralellipidones, must
be apt to fall close together, becaus y^e angles ffitt y^e
Spaces, and the like. of this wee have many Instances
That colour the Conceipt. as the shooting of salts, w^{ch}
allwais takes an angular forme as compound of re=
gular sided parts falling close together; and the
regularity of the composition, is seen in y^e aggregate.
This is most Notorious In the case of some hard frosts,
when snow comes downe in y^e Shape of Spurs-rowells,
with Six points, thus <diagram>. w^{ch} happen's from the sceme
of 6. /equall\ circles, Inclosing, a 7^{th}. thus <diagram>. w^{ch} is the ground
of y^e forme. and then y^e turning being on y^e center, & Not
flatt-wise, becaus y^e Edg passeth Easyer then y^e Side. all y^e
Gathering is by /round half frose\ dropps setling in y^e angles, & so propa=
gates y^e figure. I shew this onely here as an Instance,
that the shape of Component parts, will be propagated
thro all y^e Composition, & be Seen in y^e aggregate. And
so also, that however Irregular and unequall prime
parts of matter May be, promiscuous agitation, May
bring

bring together parts, that have formes, as I may say
conforming, and so Constitute specifick matter, such
as wee know onely In y^e^ aggregate, & give Names too
as wood water mettall stone, & y^e^ like, with Many
subdevisions; and where is an End of any thing?

But y^e^ main cause of ~~pleni~~ continuity on w^ch^ I most Re=
ly, proceeds from the plenitude of y^e^ world. ffor If I can
Shew that, however body's are not held together direc=
tly by it, yet If there be a difficulty of parting, and In
Some Cases, it may be a mean's to bring about those
continuity's of conglomerate bodys, as we comonly ob=
serve, ffor It is Not all y^e^ Earth is so Nor any very
Great part, ~~for~~ Much y^e^ greater being fluid, or sea, and
air. Therefore In order to Inspect y^e^ operation of this
caus and apply it. wee must Regard some consequen=
ces between single body's, or parts, and first, It is con=
Siderable whither 2. body's touch by points, or a point
to a superficies, w^ch^ is y^e^ Same thing; for In that Case there
is no difficulty of separtation, becaus the matter lys round
ready to succeed In place as it is Made. And it is a certein
rule, that If matter cannot Succeed In y^e^ Instant Space is
made those body's cannot part at all. ffor that is a Ne=
cessary consequence of plenitude. Then it follows that
If 2 body's touch by a superficies, as 2. flatt Marbles,
No force in y^e^ world could, If they had No pore, draw them
asunder in paralell position, for altho Matter might
succeed

Continuity ~~13~~

Succeed at y^e^ sides, It Cannot Succeed in y^e^ Midle, at y^e^
same Instant of time. Therefore wee have in that case
a plaine Mechanicall caus of Continuity; Now let this
be ~~collated with~~ /transferred to the\ Example stated of a mountaine of
bricks, Into y^e^ body of w^ch^ it is Impossible Matter should
Succed, for they must be drawne asunder paralell-wise,
becaus they defend one and other from sliding or any
angular opening; and for this reason, of necessity, that
lump must Conglomerate; why is Not the Case y^e^ Same
In Minute cases? It follows not here, that, these conglo=
merates must be indiscerpable, for, as hinted, sliding,
or angular opening consists with plenitude, and onely
parralel parting, or towards it, is obstructed. And those
mean's of parting as may be, cannot be applyed, but
at y^e^ circumferences of body's, and Not at the ~~supe~~ In=
ternall parts, becaus as I sayd the part's defend one &
other. I now leav to Candor to say If here be not, (ple=
nitude admitted) a demonstration of continuity of bodys
as are formed & meet apt for it? and how Much more
satisfactory is it, to have such an acc^o^ Conformable to
our Experience, or ordinary knowledge of things, rather
to Invent New unconceivable principles, such as attac=
tion, to w^ch^ y^e^ author of y^e^ optica ~~ascripes ascrip~~ ascribes
Continuity /w^ch^ hath its absurdity also\, ffor If such generall rule were admitted /of
all bodys attracting Each other\
why doth not all y^e^ matter In y^e^ World cohere, & why is
there any motion or fluidity, If they say some is more, others
less, & some Not attractive at all; I anser some, is Tityrice
and Some tu-patulice,[267] as Hobbs, on other occasion wittily sayd.

[267] See note on f. 171r.

14. Continuity.

But this is a sea of speculation, and it is hard to find
a signe of shoar, to give hope y^e^ voyage may End. ffor
I consider, that small body's such as Escape our sight by
many parasangs, tho aided by y^e^ most ~~demi~~ Magni=
fying Glasses; I am loath to propose to /others\ Imagination how
deminisht they are In mine, but lett what is sayd suf=
fise. I say, these minute parts, are really Conglomerates
of others, and perhaps those of other's, where shall I End?
and being so, then have all the property's of the higher
formes, up to such as wee are acquainted with; as flexure
springyness, & y^e^ like. wee are acquainted with Thornes
wool, hair, and such thing's as by vegetation are Spun
Into such formes, having such property's as those have.
wee are not to conceiv, that these are put together with
parts of Matter originall & unporous; but of ~~parts~~ /such as are\ con=
glomerate y^t^ had property's conducing to y^e^ same Ends
before they came there, and by y^e^ action of vegetation
separated from others, & put together. as to Instance
farther Even water it self, may have its fluidity, Not
Imediately from y^e^ constitution of primary parts, but
may be constituted, of conglomerate lumps, of Such
sort as may ans^r^ the pha^e^nomena of water, and En=
Couraged Cartesius, to propose them /oblong\ with flexure, be=
caus that, as he thought, did with much appositeness
Resolve y^e^ cases y^t^ belonged to water. And altho wee
doe Not affirme it as he did, wee may Say, None can
say or prove it is Not so, as May /be\ more considered when
I come to speak of water.

Continuity. ~~15~~.

I shall conclude this discours, with y^e^ Case of two flat marbles put together, w^ch^ are observed to part not W^th^out great difficulty. It is admitted on all hands, that y^e^ Effect of the airs spring or ~~aires~~ Gravity holds them from being parted paralell-wise, with y^e^ whole force of it. But some=what farther is suspected, w^ch^ is that In the Exhausted Receiver, they Cohere In some measure; I might ans^r^ y^e^ air cannot be wholly Exhausted, so some Spring being Included may have effect, but I admitt Even without any Spring of y^e^ air at all, they will Not so Readily part as one would expect. The reason of y^e^ whole matter, is this <diagram> If the marbles are to be so separated, being as they are Impervious to air, there must be an Exhaus=ted vacuity at. A. for there they are open, at y^e^ Same Instant as at B. &. C. but the matter entring, must be at B and C. before it Can be at A. therefore y^e^ Spring of y^e^ air hinders y^e^ opening so flatt wise. but Not at all <diagram> sliding by each other, or opening angularly thus .. <diagram>

But abstracting all weight of y^e^ air, wee doe not suppose marble Impervious to that matter w^ch^ is Interstitiall even with y^e^ air, but that penetrates thro y^e^ pores of y^e^ Marble and, for y^e^ More part supply's y^e^ Space. but yet the [leviga=?]ting operation, may have procured some flatts, y^t^ doe Not Intromitt such matter, and then those flatts meeting, doe Not so readily part, becaus of y^e^ plenitude of y^e^ world. this ans^rs^ that difficulty, I thinck, better then y^e^ Sorry Subter=fuge attraction.

196v

16. Continuity.

It is proper here to take a generall Notice of fluidity
leaving the particular phaenomena to proper place. it
is a condition of matter opposed to Continuity, and Con[=?]
sist's, in a perpetuall agitation of ye part's, without
any Rest; Wch agitation must be Imputed to ye force of
Interstitiall Matter. And It is probable, that ye parts or
lumps of wch it is compound are ~~Incling~~ Inclining to
ye smooth & round /and touch but by points or lines\ wch Makes them less apt /Either to
cohere or\ to Impede
Each others agitation. But when ye agitation ceaseth
wch happen's upon cooling or ~~freezing~~ freezing, then ffor
reason's before touch't the body's become Continued, as wee
see In Ice, Glass, & Mettalls, wch as ye poet say's are the
Ice of fire.[268] There needs no other Experiments that fluids
are In perpetuall Intestine agitation, then the dispersing
foulnesses, and odors; tho ye boyling Alabaster powder
wch while ye heat keeps the litle lumps in Motion, as it
Will, ye whole putts on ye forme of a fluid.

I have bin ~~thist~~ long, and sollicitous In this matter, ho=
ping to make some way into it, rather then with Mr
le clerk. succumb In Ignorance, or with Sr Is. N. fly to
Attraction. The Importance of ye Subject, the whole frame
of our Inferior world depending, on Some reasonable
Notion of it. and without Such foundation, all Natu=
rall philosofy, seem's but a Castle in ye air.
<flourish underline>

[268] Samuel Butler (1613-80) wrote: 'Melts in the furnace of desire, Like glass, that's but the ice of fire', *Hudibras*, Canto I, III, 657-8. This is one of the rare examples of RN quoting contemporary poetry.

197r

<diagram> A demonstration that the
Notion of Motu vers, [distinguisheth?]
a motu Relativo, is fals, &
May ~~apply~~ /Imply\ a Contradiction

let A.C.B.E. be the circle of a
movement. B. the body Moved
about y^e^ center by y^e^ line B.D. the
tangent. The movem^t^ of a body In Circle, is In Every
point of y^e^ circle or Moment of time considered as
Rectilinear. becaus a Circle is a poligon of Infinite Strait
sides. therefore ~~Is B~~. the Momentary state /of B\ is a recti=
linear motion upon B.D /the tangent\ for In y^e^ point of Contact
B: ~~the tangent~~ /the tangent\ is coincident with the circle. This is
motus verus, from B. ~~to~~. /towards\ D. Then /let C.E. and D F. be paralell &\ let
another force Im=
press a Motus verus upon y^e^ center H. or let y^e^ whole
body be In Motu vero (marking by y^e^ path of y^e^ Center
H.) from C. to E. /with velocity Equall with that of B. In y^e^ tangent B.D\ Then during
this Movement. the
Body B. /supposed ~~being~~ at E\ shall pass from E. to B: ~~Then~~ /observe then that\ at the
same
moment of time the body B /In y^t^ part\ shall have a true Motion
(with y^e^ whole) ~~fr~~ from B. to F. /vis^t^ from H. to E.\ and also a true Motion
from B. to D. /upon y^e^ tangent\. W^ch^ is Impossible. for If you Respect an
Absolute Space or Rest, a body cannot (truly) move /with equall speed\
both backwards, and forewards, at y^e^ Same Instant of time.

This shews the Confusion of this distinction, for Relative
motion ans^rs^. all Regards, and may be backwards & forewards
Innumer~~ber~~able way's, but motus verus can scarce Subsist
without Incurring auch contradiction's as these.

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198r[269]

Hypotheses ~~120~~

continuity.

Hence it may appear How the Geometers
may be Mistaken, who build upon Events
of complex cases, as If they were distinct
principles, such as are usually found a=
mong their definitions. &c. ffor If they find
a constancy In Effect's, they take the Caus
by y^e^ Name of vis; and so vary from the Na=
turalist's, (who say causa Efficien's);[270] saying
vis efficiens; and that vis, must be an Essence
In their work, with all y^e^ certitudes belon=
ging to Such process. W^ch^ with y^e^ Naturalists
is an aggregate of Infinite Inconstant &
Incertein causes blended together, the Effect
Whereof must be No less Incertein, & Incon=
stant, tho y^e^ difference may Not appear
nor whence it proceeds to our Gross senses.
As here that body's cohere, say y^e^ (Moderne)
Geometers, It is vis attractiva; then say y^e^
naturalists but Some harder then others,
then Say y^e^ others, it is ad modum densitatis,[271]
and y^e^ Softer are but more rare, or less dens.

But ffor demonstration that attraction,
after a magnetick way, cannot be any
caus of Continuity, this one circumstance
proves. Body's the most tenacious of their
union, have no disposition, being once
broken

---

[269] A wide LH margin is used from f. 198r-200v.

[270] i.e., 'efficient, or moving cause', one of Aristotle's four causes; note that RN has the 'Geometers' (i.e., the Newtonians) merely changing the term 'casua' for 'vis' (i.e., from 'cause' to 'force', or 'power'), thus retaining the Aristotelian structure, or logic. Note also the reference to '*vis attractiva*', below.

[271] i.e., 'according to density'.

121. Hypotheses

Continuity.

broken, have no, Not y^e least tendency, to
unite againe, and Can by No Means Even
be brought to it. As to Instance Diamonds
pulverized. If they had a specifick attractive
vertue to make the part's consist harder
or closer then other body's, they must run
together againe. but there is No Example of
the like, of that or any other body what=
ever. And If y^e powder of diamonds were fluxt
by fire, as perhaps is possible, It would cold
not have such hardness as before; but this
Referr's to experiment. No body broken with
a cleft as Exact as any talley, put together
again, will hold with any force, and accor=
ding to y^e law of attraction they must stick to=
gether as fast as before.

This Serves to Introduce an ans^r to y^e p^rtence
of the force of attraction from y^e Cohesion
of 2. polish't marbles. It is a knowne Ex=
periment, and y^e Case is onely that they doe
not without Great force separate In a pos=
ture paralell, but If heaved on one side
or Slidd one upon another, they part with=
out any Impediment; the nature of w^ch
experiment is Shewed as In y^e case of parts
Imperceptible In fol. 118.[272] among w^ch
it

[272] A rare (unique so far) example of RN making a specific page reference to his own work (although do note on the next page the reliability of his page numbering). Since this section begins at f. 120 we cannot actually reference f. 118.

Hypotheses. ~~121~~.

Continuity

It is supposed frequently to happen, when fflatt particles fall upon one & other In strata, so as the comon [serling?] of things is about y^e^ Surface of y^e^ Earth; y^e^ Caus of w^ch^ was Referred to plenitude.

Therefore to dissolve the p^r^tension for at= traction from this Experiment of two Marbles, I am to give warning here, that, ffirst the greatest If Not all y^e^ Caus of the Cohesion In such grossness, is the weight of the Atmos= phear, of w^ch^ account will be given In fit place. and whereas it is p^r^tended, y^e^ Same Happen's In y^e^ Exhausted Receiver; I deny that Can be Exhaust of Air Enough to argue that Consequence. But ffor clear= ness of ans^r^, I will admitt there may be such cohesion of flatt surfaces In the torricel= lian void. altho wee may suppose that the Ether, or matter Supplying the depri= ved air, passeth freely thro y^e^ Marbles, And yet Say, It is an Experiment that Grosly proves plenitude, but In No sort attraction. ffor altho the Marbles are mostly pervious, or po= rous to let thro y^e^ matter, yet some part's, y^t^ are small, may be levigated by y^e^ polish so as

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122. Hypothesis

Continuity

as to touch each other, flatt to flatt; W^{ch} If
It were Considered In y^{e} Whole plan of
y^{e} Stones to be so, I might affirme all y^{e} force
In y^{e} World Could Not part them parallel wise.
but the touches being upon just Not points
or very litle peices heere & there of flat ag^{t}
flatt, there is some Impediment to y^{e} par=
ting, but such as litle accidents, as shaking
laterally, or y^{e} like, soon loosens. And that
litle difficulty, If any be, all Externall air
or atmosphear abstracted, can be ascribed
onely to the plenitude of the world.

Hypotheses. ~~83~~.

Continuity.

There is No speculation belongs to the
Study of Nature more difficult, abstruse, &
I had almost sayd desperate then this. &
yet Nothing so Necessary to be understood
In order to reconcile a world of doubdts,
w^ch^ hang upon it. No Experiment can
Sink so deep in minuteness, as to Shew
us how Compounds are originally Engaged
In such union, as wee dayly In Gross see
& handle. Therefore No means is left us
tp penetrate this abiss, but reason and ar=
gument; & that I know is despised by y^e^
rigid Experimentators. are wee to stand
still and medle not till Experiment light
us, that is, I fear, for ever. and I am Sure
no good to knowledg Ever came by rest;
It is a mistress, like fortune, y^t^ Must be
Courted with daring, and then somewhat
may ffall worth clasping. there is onely
this difference between, these beautys,
knowledg, & fortune. that In Courting
y^e^ latter, many are destroyed and lost,
and Instead of favours, are payd with frownes,
but y^e^ other destroy's none, and rarely
sends

Continuity.

sends any away, that adress as they ought,
without good store of her favours. ffor this
reason I am an adventurer, In search of this
secret au fonds,[273] and If I come short, I shall
have No losses to bewail.

I shall begin with Cartesius, who onely
hath taken the matter fairly Into Consi=
deration, and made a bold proffer, at Re=
Solving how matter cleaved together. he
saw It was kept devided by motion, and
so Concluded y^e^ contrary Rest must hold it
together. ffor, say's he, the strongest[274] Glew
Cannot hold body's faster together, then
perfect rest will doe. This thought of his,
so expres't, is so farr from Sinking Into
other mens[275] mind, that it is look't upon
as a meer fantastick nothing. Rest holds
things together, but How can that be?
the doubdt is Just y^e^ Same, as If he had
sayd Nothing.

I have often Considered what should be
the Caus that a thinker so strong as he
was should laps /as he hath done.\ So Egregiously In this matter.
He is dead & cannot ans^r^ anyones doubts,
therefore

---

[273] i.e., 'fundamental, or hidden, secret'.

[274] A word, or words, have been scraped back here and overwritten.

[275] Again, a word or words scraped back and overwritten. This 'tidiness' makes the text appear to be an attempt at a fair copy for others to read.

Fluidity. 1.

Having Spoken of Continuity, and being Now dealing about principles, It occurrs to take notice of fluidity so farr, as may be propper here, to the end, It may not be taken as a distinct Nature, but As it is, onely a Mode of divers, /&\ multifarious body's. when the Shapes are Such, that they touch but in points, and Not by Superficies, ~~they~~ and doe not Interfere from any asperous or Indented Shapes, but ~~heap together~~ are of curve surface, as wee may Imagine Globules or ovalls, or towards them; It is Impossible they Should cleav together, and be Continued solids, but Remain loos, and obnoxious to all force y^{t} happens to fall and to dislocate them, according to their smallness with Eas. And for that reason it is found that the agitation of y^{e} Interstitiall Matter, keeps the part's In perpetuall Motion; w^{ch} is perceived plaine Enough In air & water, by y^{e} dispersing of Smoak in y^{e} one, and powder's In y^{e} other. There is Nothing more this In y^{e} Notion of fluidity. As for the property's of it, With Reference to Experiment, I Shall discours expresly hereafter. In y^{e} Mean time, It is to be observed, that Much y^{e} Greatest part of y^{e} world is fluid; that is all y^{e} Ether, or Mundane Spaces. and Even of our Globe here, wee Cannot say how much is fluid. so that the Continueds to y^{e} fluids are for Magnitude Not Comparable.

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<page blank>

202r

Complexitys. ~~1~~.

In this head wee are at the base, or plan, upon w^ch^
all Naturall phenomena are to be lay'd and viewed,
If wee cannot bring them to this testing table, wee Must
be suspended In opinion, till Some discovery's or Expe=
riment's will Reduce them. And In such cases, w^ch^ are /Indeed\
most particulars ~~cases~~ of Complext effects, If wee Can
Say they may possibly /be\ after this or that knowne E=
vents of our principles, it is our Non plus; that is a
meer posse, for the esse, ly's so deep In minuteness wee
may Not Comand it. Some few will fall In o^r^ Cognizance
but Not many, and as In worldly affaires, wee must
doe o^r^ best, audendum tamen; and If wee have Not
o^r^ Wills, patienza. but to goe on.[276]

1. Multiples, or body's, may be Either Conglomerate a-
Sticking together, or however Contiguous, yet be loos &
flux, without any Mutuall Cohesion at all. The former
are accounted Ever as one & y^e^ Same Individuall, but y^e^
others demand more Reflection.

1. If Many body's touch, and one is propelled that Shall
move all the rest or so many as /are\ toucht /in a direction\ from an hemis=
phere of force. I shall Instance in Globules, but y^e^ Case
is alike in all. as here, the plan of y^e^ force is. aa &c.
<diagram> bb. &c. and y^e^ hemisphers are Ima=
gined. If A. Be propelled all y^e^
Rest Move, Except. B. becaus
the contact is Not directed from y^e^
hemisphere, but In y^e^ plan e.a. it
self, so y^e^ Rest move & that stands.

[276] This is quite a macaronic episode: '*non plus*', 'furthest or most extreme point'; '*posse*' and '*esse*', 'potential' and 'being'; '*audendum tamen*', 'yet dare, be bold'; '*patienza*', 'be patient'.

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2. Complexitys.

This is No More then was Noted of 2. body's, No More,
is it to Say that Every one of these body's take a di=
rection of their Motion, by ye Contact & center. And
the describing those direction's will Reprsent to ye Eye
how ye force is Inclined this way and that, as ye Shapes &
positure of ye bodys are. And consequently as to ye
measure of ye force of each, all the Effect's of obliquity
take place; And this In a few & Regular figures, is com[=?]
prehensible, but the same cours Extends itself ad In=
finitum, and with ye very Same Solitary Rule, thro all
ye Immensity of ye World. but In Such Multiplicity, and
also Irregularity of matter, as wee must suppose pr=
vailes In ye world, wee must ow all ye Idea of it, to a
Mentall Iteration of Such Explicit Examples as these; Into
all distance, never forgetting ye originall Rules, wch I Con=
veiv never ffaile.

3. If one Great Body toucheth Many, The Complexity
is Greater, but ye cours ye Same & Regulated accordingly
<diagram> A. drives a multitude a small parts, the
force is dispersed Quaquaversum,[277] and Wee
can but Imagine Confusedly ye Manner
of it, but yet /must\ still Retein In Mind, the
rule, wch, tho unseen, Governes all. And What[=?]
tever greatnesses May be or Inequality's
In things, none are enfranchised from the Comon laws
of Motion, but In Every Instance of Impulses Great Small
many or ffew, It is ye Same, as /it is in measures of force & direction\ If any two yt
touch~~ing~~ were
ye onely 2. In ye whole world.

[277] i.e., 'in all directions'.

Complexitys. ~~3~~.

It May Indeed Happen, that Corpuscles, as well as greater
thing's may make a resistance upon acc^{o} of their Shapes
as If they are Cubick or sort's of parallipipedons, or pyra=
midall, w^{ch} May Not make them scatter afore a force so
as the Globular & ovall, as well as more Irregular things
doe. but that ~~is ral~~ in the Accidentall concourses of
body's is rare, tho sometimes Such may happen, as wee
may beleev upon the shooting of Salt's Into Regular lumps,
The Combined figure Evidencing that of the Components.
yet very rarely, as I sayd; and Wee find litle Evidence in
things to /Incline us\ suspect otherwise. at p^{r}sent I Shall Suppose it ge=
nerally so, Referring the more Nice scrutiny to the discours
of Continuity.

Supposing this Multiplifarious Irregularity, the result of
y^{e} whole tendency of a force is Not onely foreward & laterall
but also directly avers[, into?] y^{e} part's from whence y^{e} force
comes. as A. Moving ag^{t}. c. d. e. f. drives B. in the direction
<diagram> of A. Inverted. Therefore If Impediments Confine
the Materiall y^{t} it pass not free, there is No place
void that the directions of y^{e} force doth Not drive
the Matter Into tho Directly backwards, as the
Actions Called Compressure Never fail to demon=
Strate.

Those Congeries of Matter that have their part's thus loos
and flux, capable to be driven, by body's falling in a=
mongst them with a force dispers't Quaquaversum, wee
mean by fluids, & those Conglomerate, /by\ continued bodys
of w^{ch} more Expressly In their place.

4. ~~Commixtures~~/Complexitys

The manner of a body Moving In fluido, hath bin a
Subject of Much altercation among philosofers, & how
It hinders, wherein Cartesius is obscure, & I thinck both
errs & trifles. W^ch^ Matter to Explaine, I must conceive
there are fluids of divers degrees of Rigidity, Some Mor[e?]
loos & yeilding then others, & some Springy & others Not
w^ch^ Make very different modes of body's passing thro
Them.

ffirst that they May pass, & Not loos force so as to be
knockt downe as some fancy; I Shew that Every solid
passing a fluid Takes y^e^ forme of double cone, primid
or other forme of y^e^ Nature pointed before & behind,
So that It both open's y^e^ body and letts it close In form
of a double wedg, with the botomes together, & edges
avers. And this happen's of what forme soever y^e^ body
is. And the more Rigid y^e^ fluid is, or y^e^ More velocity
y^e^ body hath, the more acute are y^e^ points, and by y^e^
Contrary, more obtuse, And somtimes very litle of it
but Allwais /it\ Must be somewhat. If y^e^ body it self is Not
of this forme it takes it by Addition from the fluid it
self. as A B. moves towards. c. In a fluid, I say a
<diagram> piramid or Cone of y^e^ fluid. e. is Carryed before,
and another. d, at y^e^ Closing behind, w^ch^ as y^e^
force is violent sharpen. that this Must of Necessity
be, If y^e^ ends of y^e^ body are flat, this proves. the part [..?] in
y^e^ Midst, must have sometime to pass, If it were never so In
clined to g. or. f. so a part afore that, &c. and besides
there is Nothing to Incline it to f or to. g, therefore it is
as Covered

as Covered by y^e face of y^e body Carryed along, & so ano=
ther order, & then another, Still shorter & shorter, as y^e
parts fall off at y^e ends, & at length Coming to a point.
And If y^e body be slow, the part's Shift away faster, w^ch
If Swift will be driven along, for want of time Required
for passing on one Side. the like If y^e fluid be Rigid or Stiff.
Who Will may observe this In Currents, and It'is y^e Reason
why In y^e face, & Rere of Every flatt obstacle; as pillars
of bridges & y^e like there is allyais a triangular calme
or Stagnation~~s~~, Where straw's & light thing's lodg, & for
Moving ~~ag^t y^e stream~~, ag^t y^e Water, & stemming a stream, y^e
Case /as to this Matter\ is alike.

When y^e body urges forewards, there is no space of time
between, the protrusion before and y^e Vacancy behind. And
there is No progressive movement given y^e fluid, so as it
Should Either Much Resist or disable y^e body In its Motion
but Gradually onely. ffor it is but a laterall opening and
closing, for y^e body hath's it space Every where. As the body
<diagram> A. passing towards B. bears open some parts tow=
ards. B. and at y^e Same moment some parts
fall in at a. and by y^e Irregularity or texture
of y^e parts, y^e Same force as open's towards b.
by dispersion Every way as was Noted works at y^e closing
just as at y^e opening. So that y^e Matter doth Not Move
allong with A. bating y^e. 2. Cones onely, nor hath any great
Quantity removed /or\ with any Great Swiftness. but a litle dis=
order it Makes, rather Intestine Motion of the parts
the alltogether, but yet such force is Required as is

y^e Caus

6. Complexitys.

caus of force wasting in fluids as it doth; here is No Im=
possibility Incongruity, or Inconsistency in this Solution, with
any Naturall rule or reason of Motion; And it May Well
be observed by any thing broad & light with an [handee?]
with w^ch you may feel the air load, as you bear it Swifter.
And one would thinck y^e air run about from before to the
parts behind & make a Current at y^e Edges, but is is onely
the Motion of y^e materiall In y^e hand, the air doth but open
[.?]or chang in a laterall way. But y^e strength of that is
Such, that If a body hath not solidity considerable
or have a Strong force applyed, It Shall Stopp strait, and
It must be a hard hand to bear it thro. ffor this Reason
papers, leaf Gold, feather's /are at y^e mercy of y^e air\ & Even Birds so accoutred
bear themselves upon it. The Best view wee have of any
movement thro a fluid, is of a boat, or Ship sailing
hard. ffor after it is past by It leaves y^e water in No
Current, but onely with some Intestine purles or roun=
dings one way & other, w^ch make's a view distinguisht
from y^e other water, & /is\ called y^e wake or walk, y^t is
path of y^e ship. but at y^e prow, y^e Water seem's lay'd
aside one way, & other In folding's, becaus of the Con=
tinuall force of y^e wind urging, w^ch gives No time ffor
y^e water to Shift by particulation, as it will, when
Gently towed by an hauser & capsterne thro Calme
water. Therefore y^e More Swift y^e passages, the more
Impedim^t is y^e fluid, ffor then the displacing's for
Want of time, Extend laterally farther off, and
so disturb More of y^e fluid, then passing lesurely, as
y^e More or less Rigidity of y^e fluid demands.

Complexitys. ~~7~~.

Hence apears, the vanity of putting Cases of Motions
In vacuo, as If there were any other rule In supposed
vacuo, then in pleno fluido.[278] M. pardies, makes a Strong
use of it. ffor he says, In vacuo, the least body will
move y^e^ Greatest, in vacuo, with all y^e^ celerity of y^e^ access.
and the reason given is, that body's are Indifferent to Move
or Rest, and any force will determine that Indifference.
Then w^ch^ a Shallower proposition Could Not be put forth.
Wee allow Indifference Enough, by saying that Motion is
Nothing In y^e^ Body Moved, and consists onely In Relation
to other body's, or spaces, w^ch^ are circumscribed by body. but
as to Motion or Chang, when 2. body's clash, I would ask
him whether one Shall have all y^e^ chang & y^e^ other
None? or whither y^e^ chang (as some Must be) w^t^Ever
it is Must not be shared according to y^e^ Quantity on Either
side? I grant that any body with any Swiftnes, will
make any other move, but Not to any Swiftness, and
to Confute that it is but turning y^e^ tables, and speaking
first of y^e^ other side. Cartesius hath y^e^ like failing. and
as to him, I must needs say, y^e^ Rules, w^ch^ he & S^r^ Is. N.
after him Call law's of motion, are y^e^ Most crude part
of his work. It was a new Notion he light upon, and
had Not proved & Refined it; but as it were hinted &
Guest, leaving y^e^ Refinem^t^ to others; & treat him kindly
for it, turing y^e^ defect's to his Reproach, & arrogating
the Invention to themselves.

But to Returne as to plenum & motion in it; the Im=
pedim^t^ of y^e^ Medium, is equi/va\lent to a certein Quan=
tity of Substance added to the body Moved. and
is

[278] i.e., 'in a full fluid' (as opposed to a vacuum).

8. Complexitys
/is to be added\
as so Much of obstacle In y^e body Struck, as the Impe=
diment amounts to. And the obstacle is more or less
according to proportion, of w^ch more anon. ffor /in\ a broad
thin body y^e obstacle is more then y^e force, but in an
heavy Solid, ~~the ab~~ as a canon bulet, y^e obstacle is less
then y^e force however wasts it Continually. And If the
Stroke be with Great force, y^e obstacle is more then
When with less, all w^ch was Explained before. but I
affirme, at the Instant of the stroke, there is a cer=
tein addition of some Impediment, w^ch is Not otherwise
Influencing at that moment, then as If in vacuo
the body had a stroke with so much more of Quan=
tity added to it. It is true In y^e Supposed vacuo, It
moves with y^e Same Speed allwais, but In pleno with
perpetuall abatem'^t. but what follow's is Not In the
account of the Effect upon any Stroke that is taken &
Estimated In one moment, vis^t, that of y^e contact; the
Rest is as Nothing in that account.

It is well worth the Reflecting upon the Manner
and Consequence of this Impediment; ffor much of Conse=
quence to y^e solution of divers phainomena depends
upon it. Every fluid hath a stated ~~Rigidy~~ Rigidity
and is accordingly more or less Impediment to Move=
ments in them. Water & air are those wee know best
and Especially air, becaus wee live & move in it our
selves, as well as continually observe other things pas[=?]
Sing thro it therefore wee pitch on that, for observa=
tion's, & Examples. Then wee consider that Body's have
so much force to move, or as they say, to persevere in
their

Complexitys. ~~9~~.

their Courses, as they have Substance. And the oppo=
Sition that obstruct's is applyed onely to y^e^ Superficies.
w^ch^ Spread abroad In a fluid, meets opposition of y^e^
fluid accordingly, ffor a Surface /of. 1. foot square\ urging y^e^ fluid Must
be opposed by more of it, then If it urged but by 6. In
square; altho perhaps the Interior Substance /all y^e^ While\ be the /very\ Same.
Same. Hence Results this Hypothesis, that body's per=
severe In Motion according to their substance, and are
Impeded, or retarded, or stopt according to their Super=
ficies. And accordingly with Respect to all Movem^ts^
in fluido, wee have to consider the proportion that y^e^
superficies bears to y^e^ Substance, and as y^e^ Ration is
Greater on y^e^ part of substance, so is y^e^ force of perse=
verence, & as it is Greater on y^e^ part of y^e^ Superficies it
is less. And this ration is varied. 2. ways. 1. by figure
2. magnitude. 1. It is notorious that a granule of
Gold ~~of Gold~~, may be beaten Into a leaf, & so become ~~the~~
ludibrium ventorum.[279] The mathematician's y^t^ deal
In Isoperimetry, demonstrate that a sphear is a figure
of Greatest Content, and then wee Conclude, that So
much as a figure is drawne out from y^e^ Spherical, the
superficies with Respect to the Substance is augmented.
2. Of Magnitudes, y^e^ figure being y^e^ Same, the greatest
hath allways less superficies with Regard to y^e^ Substances
the lesser have. And to bate further Nicely, I demon=
strate it by Comon Dice. take one, & that is a cube
whose Substance is ~~one~~. 1. and superfices. (the 6 sides)
6. take the Next cube. w^ch^ is 8. Dyce. and then
the

[279] i.e., 'a plaything of the winds'.

10. Complexitys.

the Substance. is 8. and the Superficies, (each /of ye 8 sides\ having
4 sides of a Dye) is 24. and the ration of 8. to 24. is
but as 1. to. 3. So that by doubling the root, the
substance hath Gained upon the superficies one half.

Here wee see that the power of body's to Move and
persevere In fluido, as in ye Air, is variable, but the
rigidity of ye air is allwais ye Same. Whence proceeds
Some Effect's as appear almost riddles, so hard to Resolve
as for Instance, A body of water, as comon dropps of
Rain Move thro ye air with Great swiftness, but a small
drop, such as clouds & mists consist of have So Much
Superficies & so litle Substance, yt ye Rigidity of ye air
hath ye better of them, & they will Not Move at all,
against but wholly Comply with ye Movemt of ye air.; this
is also ye accº, why leaf Gold & feathers /fly about ~~&~~\ ~~as also~~ Com=
mon smoak, Enter's Into ye substance & becomes part
of it, and so doth Even Iron, when by Corrosives it
is Reduced to Impalpable dust; as In Medicall de=
coction's of steel, Every part holds its place In the
water, tho None Sinks; and the lump of Iron Subsists
In all its Quantity /in\, & may be taken back from ye water
tho No symptome of it is Either In view or at ye bottom.
Where If ye weight prvailed it Should Setle. And this Con=
Sideration Shew's ye vanity of Some that have thought it
possible for great body's to Move In ye air /& be Supported\ as birds; for
they doe Not consider, how Much substance there is
to provide superficies for In wing's or Sailes, to Make
an Equality with that of Birds. and Even Such If larg
as Bustartds turky's, Swans, &c. fly with Great difficulty,
so flying is Not for ye Grand, but onely for ye petit Mond.[280]

[280] Note RN's flip from the physics of flight to the politics of status.

Complexitys ~~11~~.

The Rigidity of fluids depends much on y^e^ more or
less action of the parts. ffor If wee take a parcell of
body's disjoyned, but contiguous, However one much
greater then the Rest, by sufficient force, might be dri=
ven thro, supporting their positions such y^t^ /they\ are not
bound up in squares, as by masonry; and also the
Gravity makes the Idea of this action Suggest More
difficulty, becaus the body's are bound In some Mea=
Sure upon another with their weight, But wee account
Not this a fluid; becaus the body's are Not In conti=
nuall movem't one by another, Striking & being Struck,
And perhaps Not a litle conserved So, by y^e^ action of
a finer matter In y^e^ Interstitiall Spaces; Now If such bo=
dys could be put into an Intestine agitation, they
would become a fluid; as wee see by small alabaster
stones, they call powder, set in a pan over the [fier?]
Shall be put in Motion, and become a fluid, as May
Evidently be seen; but It will Not Continue, becaus
by some mean's or other they come to clasp & clott to=
gether, and some will puff away in dust, & other's re=
maine fixt behind. but It shew's us Somewhat of the
nature of a fluid. And /that\ our Comon Water an air hath
Such Intestine agitation, is demonstrated, by the
dispersing of mudd & smoak Respectively in them.
And what difference there is of waters, as to the Mag=
bitude and action of y^e^ part's is Shewed by corroding
waters, Where of some will Insinuate between y^e^
component parts of Mettalls, & so dissolve <u>them.</u>

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12. Complexitys.

Now lett us Suppose, an Equall force to fall upon Every
Individuall part of the surface of a fluid, /all\ with ~~one~~
paralell direction. The consequence will be the same
as wee see from water with its weight allwais setling
to lower places, and allwais, when confined, of level
surface. for Gravity (how It happen's In due place)
is accounted as a motion Imprest on Every part, with
Equall force celerity & direction. Now according to the
Rule. If by any movement these part's may make
any way for y^e^ force to pass, they shall so Move, w^ch^
is y^e^ Caus y^e^ water run's downewards upon Every
declension (that is obliquity to y^e^ direction of y^e^ force)
and so Continues till somewhat, as pools, vessells, or
y^e^ sea Conteines it and then it takes a level surface.
so as No point is More Exposed to y^e^ force then other, but
all Equally ballanced ag^t^ it. Whereof it may be ffitt to
Shew y^e^ Reason, becaus It may be objected, If a party lys
higher then another, It Receivs the Same Impression
from the force of Gravity as If it lay lower, and If it
sinks, it must put up or rais other water, & why
Should that be? as If A. sinks It must Rais B.
<diagram> In ans^r^ to this. I say in a word y^e^ power
of A. to sink, hath a purchas, or mecha=
nicall advantage to Rais y^e^ water at
B. &. C. ffor. d. sinks to g. by y^e^ Space. d.g.
and In y^e^ Same time y^e^ Surface riseth. but
e.h. and. f.k. w^ch^ is so much less in y^e^ Same time, as
y^e^ other, Shall gaine with great speed upon it, and
so being come to the level. C.B. with a vis Impressa[281]
sink

[281] See note on f. 109r, above.

Complexitys. ~~13.~~

Sink below it, and Instead of an hill make a vally
raising the levell a litle, and then that with full force
Setles Into that levell & ~~Raith~~ raiseth it in like man=
ner above, and so it alternally Riseth & falls, In y^e
nature of pendulum motion, and ~~In~~ upon liquids is
Called waves, from what Caus so Ever, they first are Raised

It my Not be amiss here to Shew the reason of Rotundity
of all liquids, If brought to dropps in y^e air, or semi drops
on a buble. let y^e drop be oblong as. a.d. Suppose y^e
<diagram> content of ~~a~~y^e /[.....?]\ drop In y^e Sphear e.b. concentrick
at. e. If the water Comes from. a. to. k. It moves
y^e Space. a.k. and that thrusting out y^e Water
from h. to. e. It moves but y^e Space h.e. w^{ch} is
less. then A.k. therefore by y^e Mechanisme, /If a fore at a & at k oppose\ the/at\
motion of a to k. shall p^rvaile, and that at
h. be thrust out till it take y^e forme e.k.b. Spherically.
~~or In Sum~~ And It is knowne, that In our air, there is
a comon pressure in Every thing, w^{ch} is called y^e Spring
or /rather\ y^e weight of y^e air, of w^{ch}, In its time; and then the
part a. must be driven in, and. k. out. So upon a
<diagram> table a drop e.b. is disposed to be round. but
there being No pressure at. e. becaus y^e table is
a protection; then y^e pressure at. a. take place
and flatten's the drop. ~~so~~ there is y^e force of the
weight also concurring, w^{ch} is Not In a free drop,
for all part's yeilding, y^e weight is lost. but here it
urgeth at a. ag^t e. & b. & hath y^e Effect aforesaid.
and y^e More fluid and ~~tenatio~~ /tenacious\ y^e part's are, the more will
y^e Rotundity p^rvail, as wee See by small drops of Quicksilver

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14. Complexitys

The whole art of Hydrostaticks hath demonstration
from the like reasoning; as /for Instance\ the grand Rule de Insi=
dentibus Humido;[282] or /of\ body's swimming or Sinking.
vis^{t}. that when a body hath Gained so Much place
that y^{e} water Required to fill it, is Equall In weight
to the whole pressure, or the weight of y^{e} whole body
pressing, there Exactly It shall stand & sink no More.
so If y^{e} body have less weight then water, y^{t} is So Much
as Would fill y^{e} place it takes in water, then it Shall
sink, if contrarily, then swim, till it ballance y^{e}
inequality, by some part sitting above y^{e} water. This
being a very pleasant Speculation I shall extend
what I would say, perhaps a litle beyond what my
designe Requires. the peice. A. sinking in water, acts
<diagram> with y^{e} weight of y^{e} whole continually. but the
water Resisteth onely by so much as is put out
of place. for If y^{e} water In y^{e} Space d.b.c. be
put out It must rais y^{e} surface d.c. so much
as it is (and more or less /In height\ as y^{e} Surface is broad, ~~& y^{t}~~ /w^{ch}\
matters Not, ffor whither y^{e} water riseth to y^{e} wood or
y^{e} wood /sinks\ to y^{e} water, y^{e} Case is y^{e} Same, w^{ch} difference
proceeds, from broadness or Narrowness of y^{e} vessel) and that
Raised presseth downe and Meet's with y^{e} wood w^{ch} being
of equall weight is ballanc't. The case of a wave is
Exact Equality, ffew thing's are so Just, but will Either
rise or sink.

And thus it is a boat, tho Made of lead Shall Swim,
ffor y^{e} hollow of it, tho Empty must put solid wa=
ter out of place, that is Rais it. So that y^{e} acc^{o} of
sinking

[282] '*De insidentibus humido*' i.e., '*On floating bodies*', the title of a tract attributed to Archimedes (the 'grand Rule' of which is that a floating body displaces its own weight in fluid).

Complexitys ~~15~~

Sinking or Swimming, is Not from y^e^ Materiall as from
y^e^ forme of y^e^ body, sitting on y^e^ water; The reason of
w^ch^ gave occasion to an experiment of a Nature so
Amasing as to be made a country shew, as a sort of
Magick. It is an Image hollowed with vent under=
neath, & poysed /so\ as y^e^ vent Shall be allwais downewards.
and also so as It shall equipoise its place in the Wa=
ter and ~~then~~ /being but in a deep Glas vessell, with a leather cover closed\ It doth
Just Not sink. Then Secretly with
y^e^ hand press in y^e^ Cover of leather, & contract y^e^ air
that presseth y^e^ water Into y^e^ Cavoty underneath; where=
by the ~~solid~~ place of y^e^ figure, (for y^e^ Cavity is less) is Water
is Not so Much, as to hinder y^e^ discent, & then downe
it goes, Releiv y^e^ pressure aloft, & it Riseth, so the
Rising and falling being In y^e^ power of y^e^ hand, & not /readily\
perceived, The most of y^e^ spectator's are wrapt in admi=
ration. Here If y^e^ leather be comprest from a. to b. It hath
<diagram> this effect, of w^ch^ here is a description.

The Comon plumers have an opinion, that If
a Reservoir of water be Made tunnel-fashion,
the force of y^e^ weight contracting as It Narrows
will make y^e^ water Rise above y^e^ levell, at y^e^ vent
As the Surface being A. & y^e^ Narrow at B.
the water Shall run out at C. above y^e^ vent.
If so No need of farther Experiment of a
perpetuall Motion. ffor the water at. C.
hath y^e^ same force to Come back, as a Wave on the
surface to Sink; y^e^ Case being y^e^ very same. and as to
pressure

16. Complexitys.

pressure, is measured by what can pass as was Noted
But If an accessionall pressure be applyed to y^e^ Water
In y^e^ tunnell, or y^e^ tunnell riseth with a force ag^t^ y^e^
water in it, then the ~~wallt~~ water at y^e^ vent will
pass above y^e^ levell. This latter of Moving the tunnell
<diagram> not ill shewed by a Comon hunting Horn. If the
larg End be thrust Into water In a posture per=
pendicular, from A. below. B. the water at
y^e^ litle end shall spout up In y^e^ face of y^e^ doer
very surprisingly. for a Great body is Received
at C.D. & being urged with y^e^ force, will pass
up y^e^ tube, as being Easyer then to Croud y^e^
out water before it; and when y^e^ Content of y^e^
larger part Comes into y^e^ lesser, It shoots out In
swiftness according to y^e^ proportion, as was shewed.

I had Not made a declaration of such ordinary passa=
ges as these, but cheifly to Shew wee need Not torment
body's, to Extort Nicety's In y^e^ way off experiment, but
Wee stumble on Effects, & Events, in y^e^ Comon transation
of time, sufficient to shew ~~the~~ Enough to prove y^e^ principles
wee goe upon.

plenitude. ~~1~~

I find y^e^ vertiosi of this age strangly addicted to the
opinion of vacuity, and to oppose that of plenitude
In y^e^ world; There may be much of Earnest, and Not
a litle accident contributing to it; ffor with due Res=
pect to philosofy, I must needs say philosofer's are
very apt to walk, as harmeless sheep, one after another
in a track. And the proceeding of Cartesius hath Not
y^e^ Suffrage of any gowne, but a Confirmed opposition
from all; w^ch^ hath bredd a kind of mode to slight &
Resist almost all his tenents; and Some have direc=
ted their whole study, to demolish them, & deminish
him; as Is most apparent In y^e^ 2. late peices of y^e^ prin=
cipia & y^e^ optica. And I see y^e^ Spirit In Nothing more
then this /opinion\ of vacuity, w^ch^ is so much harder to uphold
thro y^e^ necessary consequences then plenitude is, that
I cannot Imagine, /y^t^\ upon y^e^ Square, any one Should Chose
y^e^ former. That sort of logomachy raised about Carte=
Sius manner of Expressing his reason's, I have touch't, &
In that y^e^ Main Question, discoursing of principles. and
litle remaines to be added, and even that, In a subject
so remote from sence & Experience, and Indeed Metaphi=
call, besides hackneyed by all writers Into Dullness, might
also be Spared. yet I cannot make so slight of y^e^ Ques=
tion, thincking it of y^e^ last Import to truth In philosofy
If it Could be certeinly decided, to pass it by without [a?]
affording

[283] The following pages (up to 213v) appear moderately damp-affected and in places suffer from the chalky-white marking described above (f. 12v).

affording it y^e^ Countenance at least of those Reasons, w^ch^
~~to~~ /[with?]\ [me?] seem to carry y^e^ Scales on y^e^ side of plenitude, and
answer y^e^ discourses one with discourses y^e^ other, as I
thinck they merit.

1. for plenitude wee say In generall, that it is Neces=
sary, as a vehicle to transmitt such Influences as wee
know pass /to &\ from divers part's of y^e^ world, and very Remote
from Each other. and of that sort principally is light,
w^ch^ comes from y^e^ remotest visible stars, of distance from
us Inconceivable to our Eye, and Must have a Medium
for y^e^ Conveyance. ffor the Saying that light is a Reall
Emanation from y^e^ luminary, is a monster of opinion,
like that of the lucretian Species,[284] and how Reasonable
people can Imagine such a thing, I cannot Conceiv,
but I will debate this No farther here, but leav it to y^e^
chapter of light where it is Canvas't. but take this
dilemma, If light be not Corporeal, It Cannot touch
our Sence, for our organ's are body, and Nothing Naturall
but body will move them; If light be body then it fill's
the whole space round about it with it self. If they say
It is body, true! but then very thin, and light. I ans^r^ If it
be any thing it hath all. 3. demension's, and that's as
much as Gold or Quicksilver hath; and If it be wire drawne
Into thin thredds, here or there on, as they May Call y^e^ Rays,
then here & there wee may see no light at all. ffor If they
are but moderately thick sett at this distance (and
that

[284] RN refers here to the notion, attributed to Lucretius, that vision was the result of the continuous reception of 'species', or abstracted forms, of the things seen, passing through intervening space and entering the eye. This was an early intromission theory of sight with a following in the middle ages, for example Roger Bacon promoted the idea. It must be clear by now that RN does not believe that light is any kind of 'substance' (corpuscular or otherwise), but rather a vibration transferred through a medium from an originating force. RN's questioning of light's substantiality, and the possibility of 'rays' (which of course, as he argues, suggests that there may be a darkness *between* the rays) is a charming piece of argument.

plenitude. ~~3~~.

that they are, for wee cannot find a point In w^ch^ y^e^ least visible starr is Not perceived) they Must be Crowded Into a body of Materiall, neerer the center of y^e^ light. In short There are Such heaps of Inconsistences, In this fancy of vacuity In y^e^ Great Interplanetary spaces, that it is a paine to thinck of Removing them.

I know well that the Said Author among his Query's after y^e^ optica, treats this mundane matter In a style of ridicule & Contempt, calling it Comentitious, & I know Not what; It may be litle Considering with what Justice the ~~likma~~ like may be Retorted, as to his vacuum. and If any thing be Comentitious It is that. ffor wee Shew a Necessary use of plenitude, and thinck thro vacuum No light Can be discerned; therefore the Matter of y^e^ World is not a thing Invented as a chimera ffor nothing, and tho wee cannot flye thro it, wee may have reason to beleev Somewhat must connect us & y^e^ luminosity's, of a sort that can Make us Sensible of them. But vacuity, is Not onely Nothing, but Contra= dict's the process of thing's In y^e^ World, as wee are able to Judg of them. I doe Not stay to shew farther Excellent uses of the Ether of y^e^ World, but leav it to Indifferent Judgm'^t^, upon what is Shewed, whither plenitude or va= cuity with most right Challengeth y^e^ title of Comentitious.

It may be proper to take Notice here of a Midle sort of opinion touching vacuity, and it is that they call Intespers't, y^e^ same as In lucretius. - mixtum rebus.

4. plenitude.

rebus Inane.[285] This is thought of to Reconcile the difficul=
ty's of motion in, y^e^ world, w^ch^ they say Cannot be without
a vacuity. And the cases that happen creating this diffi=
culty are 2. the 1. is Angular space, the. 2. is paralell
spaces. these must, In y^e^ promiscuous turning of body's, as y^e^
corpuscular philosofy supposeth, almost continually
happen, and It is Imppossible, say y^e^ vacuists, that matter
should fall in, to Supply them, and therefore body's once
closed, can never separate. Now to this I have. 3
Answers.

1. Interspers't vacuity is no Releif att all, ffor y^e^ Matter
of y^e^ whole world moving round [Crouds?] from y^e^ Center, &
then there is y^e^ force of y^e^ whole, ag^t^ y^e^ movement of
Small part's; becaus If by the motion body's circumjacent
must be Removed Into Empty Spaces, they must be Re=
moved Into y^e^ very center of y^e^ Sun, where y^e^ vacuity
If any must be, the rest is crowded as close as possible.
This ag^t^ the Intersperst vacuity.

2. As to the Body's. In case of plenitude, necessary to Sup=
ply all occasion's of motion, y^e^ smallest as well as y^e^ Greatest,
I ans^r^ that It is Not Necessary that body's touching should at
Every Instant of time part from Every body y^t^ touches them,
but they may cohere for some time, & then part, and So
continually some cohering & some parting, maintaines
the action of fluidity Sufficiently. And It must be Remem=
bred that In y^e^ chapter of Continuance, plenitude is made
no slight means of body's cohering in lumps, as are [our?]
ordinary

[285] 'mixtum rebus rebus Inane', i.e., 'things mixed in emptiness'; RN is alluding here (none too precisely) to Lucretius, *De Rerum Natura* I, 656, etc..

ordinary Compounds, so that if bodys cohere for want
of liberty to Move, It is as usefull In Naturall philosofy
as any other Naturall consequence what ever; but
That this difficulty may Not be a totall obstruction
of Motion In fluido, I must Referr to y^e^ chapter, of [~~...~~?]
Infinity, where it is Made probable that matter is Not
onely capable mentally to be devided in Infinitum, but
that there is actually part's in all limitts of Space some
that is small, beyond any assignable smallness. where=
by the occasions of motion If not Intirely, yet are great=
ly supplyed, Especially y^e^ angular spaces y^t^ open gradu=
ally.

As to flatt superficies touching, I doe verily beleev with
Cartesius that they doe Cohere, but Not for his reason
y^e^ Rest is like Glew, for w^ch^ expression he stands Corrected,
but ffor y^e^ reason touched before, that is plenitude. for
y^t^ Granted It is Impossible, they Should open otherwise
then laterally. for be matter as was sayd, actually
Small ad Infinitum, It cannot be at y^e^ Edg, & y^e^ Midle
of a slitt In y^e^ Same Instant. And hence may also pro=
ceed farther, In Not y^e^ cheif Caus of Continuity; w^ch^ I
doe Not agitate here, but, with y^e^ Case of 2. flatt Marbles,
Referr to that Chapter.[286] And Considering it is a Case
that Seldome happens, and among Some Speciall sorts
of matter onely, the difficulty is No argument at all
for vacuity. And so farr onely ~~is it ma~~ It is discoursed
Here.

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[286] *See* f. 188v, above.

2. Another Argument wee use ffor plenitude against
vacuity, is from conformity of nature, w^{ch} is so ffar ob=
served to take place, that when any Effect's & their
causes cannot be nicely Inspected & Collated, yet If
they have analogy with other's, that are perfectly
understood, there is reason to argue y^{e} former to be
as the latter are, untill some specifick discovery makes
y^{e} Case plainer. And accordingly In this Case of plenitude
wee prove it by our senses in all possible tryalls; and
no Empty space, was Ever yet found out, great or Small.
Then what reason is there to beleev there is any,
Since no Inconsistency, or Contradiction can be Chargd
on plenitude? This is an argument from sensation
w^{ch} is a proof of the thing so farr as it goes, and a
p^{r}sumption as to all y^{e} Rest.

But on y^{e} other side, the argument's are all from Ima=
gination, without any step of proof from sence. ffor If wee
Reflect how our notion of vacuity Comes, there will ap=
pear small reason to deferr much to it. And If the
Notion were never so /legitimate &\ clear, It lying onely In Imagi=
nation, [~~...~~ is?] and that doth Not prove /a\ reall Existens.
The Idea of vacuum, is but the feigned Image of an
Exquisite transparency, or Space full (as May for all
that be,) of Invisible materiall, or such as No sence wee
have will discover. Now lett us Imagine that In truth
all places are ffull, and wee had faculty's to know
perfectly that fullness, by some discernement of the

body

plenitude. ~~7~~ [~~7~~?]

body wherever it was. and No Such Image, as wee have
from (Seeming) Empty vessells, had ever bin Impres't,
I appeal to thinker's, if In that Case a notion of vacu=
um, would Not have bin pronounced comentitious &
a chimera.

I Illustrate this by our Notion of time, or duration.
w^ch^ is such, that wee can by No mean's Imagin any
privation of it, or that it can ceas. Nay wee Cannot
In any Sort conceiv time had beginning or can have
Ending. and one that talk's of a vacation of time, will
be derided. the reason of this is, that wee are allwais
sensible of y^e^ transit of things, w^ch^ to us is time. and ei=
ther in person, or by Relation, & the survey of succee=
ding thing's , this sence of time is ffilled up, tho wee Sleep.
And there is No object that can put in our minds, (~~as~~ w^ch^
the (seeming /Empty\ vessell doth a to vacuum) an Idea of
cessation or negation of time. So that If the Image
as to Matter, as it is for time, allwais full, and Never
Representing y^e^ Negative Idea, of y^e^ one More then it
doth of y^e^ other, wee should as litle Imagine vacuum
as wee doe a [..vacation?] or blank in time. So dangerous
Is it when wee argue to the reallity of things from our
Imperfect Images, or as wee better Express it, Imagination.

There are some other colour's made use of, & par=
ticularly by y^e^ author of y^e^ principia, for vacuum. as
that body's could Not move twice their diameter
thro

thro a fluid, and most fluid would be y^e^ Same Impe=
diment to motion. ffor If a body be opposed by Equall
Quantity (as it must If all places are full) y^e^ Motion is [....?]
[....?] away. ffor ans^r^ to this, I must Referr to y^e^ discours of
fluids, where it is Shewed that as to the motion of the
part's, there is an Exact Indifference or ballance. and
body's that move thro them, doe Not Move the Quantity
of their substance, as to take a progression, but by deter=
mination onely; whereby the activity of y^e^ part's /make these\ take
the way to accomodate y^e^ Motion, rather then any other.
And this is Resembled by a ballance, with 100. /~~ll~~\[287] w^ch^ In Each
scale equilibrated. one . ~~ll~~. put in Either moves the
200, by determining y^e^ ballance, & it Cannot be Sayd
that, that pound gave y^e^ Motion to y^e^ whole Mass, but
determined a movement y^t^ Gravity Inspired; therefore
this argument is a fucus.

[287] RN uses the form of crossed 'ls', a sign for '*libra*' (pound), and equivalent to our own abbreviations '£' or 'lb'.

plenitude. ~~1~~

I find y^e^ vertuosi of this age strangely Inclined to up hold
vacuity and to oppose y^e^ plenitude of y^e^ world, w^ch^ I Im=
pute as Much to ~~y^e^ spirit y^e^ activates them ags^t^~~ /a generall mode of opposition to\ Cartesius
as to y^e^ Reason of the thing; ffor with due Respect to phi=
losofy, I must say the philosofer's, run too much /in heards\ ~~Into party's,~~ and ~~it is~~ to me /it is\ seen In Nothing More then In this ~~particular. As to the wording part of the Question about~~ /Question. so much as concernes the logomachy occasioned\
~~w^eh^ much advantage us taken~~ /by\ ~~ag^t^~~ Cartesius, ~~I have~~ /manner\
~~past it over~~, /of Expressing himself, I have touched In\ discoursing of principles;
And ~~the~~ /[~~...~~?] Some that\ Reasons
one way, and other /with answers\ I Intend to debate here.

1. ~~The cheif argument~~ /wee say In generall\ for plenitudes, ~~is~~ /that it is\ the ~~transit or /recess\~~
~~Conveyance~~ /vehicle [..... ~~.....~~?]\ of Influences ~~thro y^e^ whole~~ /y^t^ pass about y^e^\ visible world, as ~~that~~ /& [particularly?]\
~~of~~ light ~~& heat~~ /w^ch^ could not otherwise ~~pass~~ come to us /as they doe\ from y^e^ Remote luminary\ ~~w^eh^ are Such as affect our sences, and those take nothing but from body, and therefore the medium of~~ /for Nothing can Convey nothing, and If y^e^ light be [anie?] it is something\
~~light and heat must be corporeall~~. /& corporeall too, Els it Could not affect our Sences, w^ch^ manifestly
/nothing but body will touch.\ S^r^. Is. Newtons Interplanetary vacuity; ffor there is this
dilemma, If light be Corporeall as he himself Insinuates,
then the spaces must be filled with ~~it~~ /body\, for No place is free
from light, where no obstacle Covers. or If it be Not Cor=
poreall, then it Cannot move body, & so /cannot\ affect o^r^ Senses.
But it is senceless to make light a progressive Emanation
from y^e^ luminary's to the Eye, and It must be Conveyed
by an Intermediate action, as will be shewed under y^e^
title of light & Colours. and that Supposed, It Will be
allowed, that the great mudane Spaces cannot be

as he

2 plenitude.

as he holds Empty. And I cannot but Wonder at his fancy,
to Make a jest of plenitude, and Calls ye Supposed fluid
of ye World, a chimera, & dream; when much more of that
If it be justly considered, is due to vacuity; ffor wee have
work for a solid medium to Imploy it, that is Boy=
ing ye planets, & Conveying light. So it is Not a dream
for ye Sake of nothing. But I wonder what is ye use of
vacuity, ~~unless it may fill~~ /but to Supplant\ ye Irish man's caracter of whipt
cream, - an huge great Nothing.

2. The next Argument for vacuity, is The Experience
wee have of plenitude /in\ ~~of~~ all places, and None of vacuity
In any. Therefore without some Inconsistence or Contra=
diction Implyed, ye scales lean to ~~vac~~plenitude against va=
cuity. If empty space be Not, on ye other side, [~~..~~?] Contradiction
as ye Cartesian's Contend it is, yet it is a Solaescisme, ffor why
is such an Empty article in Nature? Space for No reason
& to No porpose, yt wee know. The Neerest that wee know
of vacuity is ye ~~derelickt Sp~~ derelict Space In ye barometer,
and ye exhaused Receiver. but Wee find those both pass light
without difficulty, and sound with some deminuition. And ye
Creeping of Insects upon Glass shews it a very porous body,
however polish't & Glistning, altho it impervious to air.
Therefore what Should Exclude ye Interstitiall matter of ye
air ~~to Enter~~ /from Entering thro pores of Glass\ Into ~~them?~~ those spaces in Great
Measure Eva=
cuated of air?

215r[288]

before I move further it is Requisite to answer
Some objections, as first that fire and y^e^ cordiall heat
of Animalls are very different, to w^ch^ I ans^r^ that fire is
a genus of w^ch^ there are divers species, but In gene=
rall of y^e^ same Nature, that is to kindle burn & /If not nourisht\ wast, as
Ignis Lambens Ignis Ardens, & Ignis vivificans,[289] w^ch^ two latter
agree in all Respects but onely in degree, the animall heat
will Not continue without proper fewell, but without tearing
all in peices continues its degree. and Comunicates motion
and warmth to y^e^ whole mass. And for such porposes the
animall is vascular, Repleat with liquids of various sorts
and Consigned to different channells for y^e^ use of life and
all these dependant on y^e^ center y^e^ heart, and caus severall
operations, as y^e^ utensills of y^e^ Athanors tower.

Now to ans^r^ what is cheifly demande touching their
muscular force, I must Remember what was said of y^e^ force
of fire Especially In Explosions, that it was Not by y^e^ direct
power of y^e^ fewell, that made y^e^ bastion rise, but /by\ the forc of
the subtile matter circumambient that drove y^e^ kindled
fewell into that violence.

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[288] This page is a fragment on the subject of fire and explosions. It is in a very cramped hand, perhaps indicating the RN was using a different pen. It is very likely a late piece of writing (see, for comparison and correspondences, the essay on Fire in BL Add MS 32546, f. 112r ff).

[289] ie., 'kindling fire, burning fire and giving-life-to fire' the latin forms of RN's previously stated (and rather Aristotelian) classification of the forms of fire. This is further evidence of the continuing employment of scholastic notions such as the four elements within the 'new philosofy'. The Athanor's Tower referred to below is a kind of furnace used by alchemists; they would normally have more than one oven.

215v

<page blank>

216r

Of plenitude 1.

This is opposed to vacuity, /to\ wᶜʰ I find ~~this~~ /yᵉ pʳsent\ age /more\ Incli=
ned ~~to hold~~, for ~~most have~~ /generally it is\ determined that way, but
/on yᵉ other hand\ Cartesius ~~builds much upon~~ /Rely's on\ yᵉ plenitude of yᵉ world, for
wᶜʰ yᵉ ~~more modernes~~ /rest\ bear hard upon him. The /greatest\ advan=
tage they take is from his manner of Expressing him=
Self, wherein ~~I owne~~ he /hath\ Relyed too Much upon words.
ffor say's he, Extension is yᵉ Essence of body, therefore
body and space are all one, and vacuity a contra=
diction. the others say Space may be Extended without
body, and it is not necessary that space extended, and
body Extended should be yᵉ same thing. So they differ,
cartesius had better /have\ argued upon yᵉ probable, that is
since wee find Extension to be yᵉ onely property of body
(for No other can /any way\ be proved permanent /in it\) what reason
is there to thinck Every Extension should Not be alike;
It Might be added, that all knowne Experiments /argue towards\ ~~prove~~
fullness, and None /towards\ vacuity; The derelicted Space In the
barometer hath most of Emptyness wee ~~can procure~~ /know\,
and that Convey's light, wᶜʰ Could Not be, If Nothing
were in it. And as for ascribing to body Essences, of
wᶜʰ there is no glimps of proof, as they doe, who
make it other then Extension; They May with
~~Such~~ /like\ liberty make any thing, out of any thing.
It is but saying, there are such an Such essentiall
property's in body. so there will /be\ Neither certeinty
nor Conclusion of any thing, wᶜʰ is Not a philosofi=
call way of proceeding.

2. plenitude

The others argue onely from their owne Imagination
that is, say they, wee have a clear Idea of vacui=
ty apart from all body, and therefore it may be;
and If it may be, they leap to, it is. this ~~way of~~ /is arguing\
~~arguing is not philosoficall~~, a posse ad esse, ~~Non~~ /[Quod?]\
~~valet argumentum~~,[290] Nor Indeed doth any Necesity
or reason of Existence follow from our Imagination
/to any thing\ one way or other. besides our Idea of vacuum
is but y^e^ Image of an Exquisite transparency, or
space full of Invisible materiall, or such as no sence
wee have will discover. Now If it had so happened
that all body whatever were visible, or wee had
some other Intuition to know body, whereever it
lay, and had Never found or knowne any Space Such
as, (seeming) Empty vessells, without a Repletion
of body, the Same argument would have held y^e^
contrary way; and wee had sayd, wee had No Idea
of vacuity, therefore there is none. This is demon=
strated by our Notion of time; wee hold that If all
body were annihilated and Consequently Motion,
w^ch^ to us is y^e^ Measure of time, yet there must be
a duration of things, and afore & after would Re=
maine. ffor Say wee, wee have No Idea of a possi=
bility that time Should Ceas. and with good reason
/for\ no moment of our lives ~~being~~ /is as wee thinck\, out of times way
as wee

[290] i.e., 'arguing that what is possible must therefore be is is not valid'.

plenitude 3.

~~as wee thinck, tho wee Sleep, for~~ /an If wee are asleep, wee suppose\ others are awake to
keep y^e^ acc^o^: so wee conclude time hath No vacuum,
lacune, or determination; but If by an almighty
power, wee had a tast given us of a void of time,
or Some Idea of it, (as y^e^ Story is of y^e^ 7. sleepers, &
all y^e^ world had slept for company), & this vacancy
/were\ made sensible to us; then wee had argued for ces=
sation of time, as now /wee do ~~from like Idea~~\ for y^e^ Contrary, and /from like Idea\ for vacu=
ity of Space.

Therefore it seem's to Me that Cartesius hath the
best of the caus, for he lay's his foundation on Ex=
tension, w^ch^ wee cannot prove In any Case pene=
trable, & so he takes it for body, the other's work
upon Imagination, w^ch^ is chimericall, & knowne
to be so in a world of Instances, ~~w^eh^ concludes Nothing~~ /~~of they make concludes Nothing~~
\.
Cartesius hath another passage /of\ w^ch^ they /make\ ~~turne into~~
Redicule. that is, /that\ y^e^ sides of a vessell Empty, or
having Nothing between /must touch\ they ans^r^, It is a jingle on
y^e^ words Nothing ~~between~~, for Space, say they is
between; he ans^rs^, that space being (admitted) /empty that is\ No=
thing, his consequence is true, & so y^e^ [Saw?] is drawne,
~~It is~~ /and\ all ~~upon~~ /~~about~~ for\ a chimera; for If an almighty power
Should say, let all body In that vessell be nothing, ~~whither~~ /it doth not\
/follow\ the sides ~~should~~ /must shift place &\ move neerer ~~or not, is another matter and Requires an Express will too caus it~~ /there must be another fiat, for meer
emptyness, as wee suppose\, so ~~that~~ y^t^
~~same act y^t^ creates a vacuum (for who can~~ /~~deny that a~~\ /a\ ~~limit~~ /includes body-less
space._

4 plenitude

~~an almighty power doth not bring y^e sides together~~
~~that of~~ /so that on\ Cartesius /side it\ was rather a peice of witt then of
reason, and hath ~~neither~~ /not\ deserved so Much notice.
as other's & wee have taken of it. ffor It is certein that
vacuum is no contradiction, without admitting this
proposition, that all Extension is body, W^ch None Doth
and his argum^t for it, as was toucht, amounts to No More
then a probability, w^ch who will may Contravert or deny.

The sole argum y^e for vacuity of any force, is the
difficulty, some say Impossibility of motion, If y^e World
be perfectly filled, and No Empty spaces left. ffor Say
y^e vacuists, in the various turnes of contiguous body's, the~~re~~
~~must~~ /~~frequently~~\ ~~happen~~ /~~and t certein~~\ ~~some spaces~~ [comencing?] /interstices must be
\ Either ~~paralell~~
Angular or paralell, ~~w^ch must be~~ /and these ~~so~~\ small ~~beyond any~~ /ad Infinitum\
~~possible smallness of~~ /~~And~~ so as\ matter /cannot be supplyed\ to fill them; ~~so that~~ /
whereby\ It
~~being~~ /becomes\ Impossible /that\ ~~such spaces can be exactly ffilled~~
~~there being no~~ /without Some\ Expedient by vacuity's ~~allowed~~ In lieu
of body In those spaces /that any motion should be\, as let 2 body's open /angularly\
as at
<diagram> B. the space. B. must comence /at B y^e Opening\ in Minute=
ness ad Infinitum, ~~much more~~ /then what is it at y^e Same Instance\ at y^e Angle
A? so that unless y^e Space B.D be void at
the Inception of the movem^t the Body's Cannot part
at all. ~~So~~ /Neither can\ the flat contact A.B. ~~cannot~~ part by
<diagram> a paralell /space\ without vacuity, for /y^e same reason & also for this
farther reason vis^t\ at the Same
time B.A. opens. D.C. opens. and y^e Matter
must have some Space to pass from A. & B
to D.or C. for No Motion from one point to another
is In an Instant. therefore without a vacuity at D & C.
the body's Cannot part~~,~~ att all In that posture; and
so upon the whole without Interspers't vacuitys there
can be No /such\ Motion's, and other motions /as Meer\ centrall doe Not ans^r
the

8. plenitude[291]

are Corporeal, and that turnes to body & body to
light alternately. but light must act corporeally
or how could it create heat, and vision, y^t^ is move
the organicall Conducts to sence? then these
vacuum's are ffull of light, w^ch^ is something, &
that must be Corporeall, but If it fills a vacuum
It is, In his Sence, Nothing.

So that upon y^e^ Whole, there is such a necessity of
plenitude for Conveying y^e^ Motive Influences, wee know
are Conveyed about y^e^ World, that It seem's to me
perfectly an humour to maintain vacuity, Especially
In that Extent, as this author takes it. And It is My
opinion that Had Not Cartesius built so Much upon
plenitude, and a spirit hath risen amongst the acca=
demick vertuosi to contradict, and, as they would fain,
/In Every thing\ Confute him, this chimera of vacuity had Never bin
carryed so farr. ffor ~~whence a~~ when once a faction
declares a thing, w^ch^ is Not critically demonstrable
but problematiq as this Question is, there is No beating
them out of their fastness, nor satisfie, y^e^ sectators of the
disingenuity of such confederate proceedings.

So Much for the Question of plenitude and vacuity.

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[291] The following two folios (up to f. 219v) have been numbered and bound the wrong way round. To follow the rest of this version of the chapter on Plenitude, go to f. 219v and read back to this page.

7. plenitude

all y^e Mundane matter to Move about y^e Sun. and
then If there be any vacuity it must be in y^e Suns
center, or In these planetary Sub-vortexes as /Saturne\
Jupiter & y^e Earth, y^e Matter Rolls about with y^e
Earth In a diurnall motion, but Retarding from
y^e Surface as y^e Sphere Inlargeth. so If any vacuity
be It must be at y^e Earth surface, or Center, ffor all
matter Rolling about an axis, or center, tends
In tangents to Remove from the center. Wee Must Mak[e?]
a Crowding outwards. And then I appeall to Judgmn[^{t},?]
whither It is likely the turning Motion's y^t Minute
part's may Impress upon one & other, be of force to
Resist this comon pressure outwards, or Whither this
be not an obstacle to motion neer, as violent as
plenitude itself, according to y^e objection?

But as ~~to then~~ to y^e other fancy, of almost universall
vacuity, I should have somewhat more adoe to ans^r
It if y^e author did Not furnish such copious suply
of arguments. ffor doth Not he suppose body's, and
most Eminently y^e planet's to attract one and oth[er?]
how can this be thro Nothing; Surely If one body
draws another It must be by Somewhat; And then
the space of this conveyance is Not Empty. what
is In it? attraction: what is attraction? If they Say
a vertue or a power, but Not body, I Reply /with a Question\ Whither
is this or plenitude, most a chimera? but he
hath yet Grosser Measures. light wee know passeth
thro these vacuums, and he says light or Rays
are

~~5~~.6. plenitude

true, that flatt Superficies will not open In that po=
ture, for the reason given, but a litle Inclined or
Sliding one over y^e^ other they part without y^e^
Impediment here shewed. Therefore where[292] flatt
superficies are Compact together, so as neither to
Incline nor slide off, body's must of Necessity Co=
here, Such as are the casting of salines boyled
Into Regular shapes, comonly observed. But this
argues onely some Impediment to motion, but Not
an obstruction. ffor It may be there are [~~vel~~?] very
seldome plan superficies meet; parts of matter are
So Irregular or Curve that they generally touch
but by points and then all this Argument failes,
And Admitting such planes touching as In y^e^ ob=
[jection?] the difficulty of parting them, that is
they May part some way's but Not others, there is
but a Ground for Continuity or Cohesion of Matter
w^ch^ is Most of all needed, In ~~y~~^e^ naturall Science.
~~So Much for plenitude and vacuity~~.

But there is more yet against vacuity. Some hold
It but Interspers't as necessary to ~~a~~Accomodate loco=
motion. others as S^r^. I. N. not onely that, but also y^t^
the whole sphear of y^e^ Sun's Regiment, except a
litle where y^e^ planet's are, is all vacuum. and the /generall\
~~plenitude~~ /matter or fluid of y^e^ univers\ w^ch^ Most express by y^e^ word Ether, he
accounts a Chimera; as an Invention of y^e^ brain
and of No use. as to y^e^ first addmitting what is
supposed possible, motion would Not be more acco=
modated, then if there were None; ffor wee allow
all

[292] There is a small hole burnt through the paper at this point.

plenitude. 5.

The manifest appearances In Nature.

I Should have had occasion to discours of these Cases
If the Objection had Not ledd to it, because the/y\ ~~yare~~ /are\
Not a litle conducing to explaine, the reason of
Continuity, as may appear under that head. In y^e^
mean time, as to y^e^ p^r^sent porpose; ffor accomodating
the angular spaces, there is generally, If Not universally
matter actuall small, as y^e^ Spaces are, to Infinite.
so that whereever ~~are~~ Spaces are assigned to Require
a smaller Matter, I ans^r^ there are at hand Matter yet
smaller to fill them, & so as often as y^e^ Question
Returnes, as y^e^ Mathematitian's deal with cases of
Infinity. they will Reply, that this is Gratis dictum, &
I cannot prove it. true, but they cannot deny y^e^ pos=
sibility of such, w^ch^ were to assert a minimum, that
none p^r^tends to doe. then if it be possible, & Nature (as
supposing plenitude it doth) Require it; I desire
a reason why it should not be, as whither It Imply
any Contradiction or Inconsistency /to or\ with any other
truth. This is Enough to ans^r^ y^e^ objection. but admitt
it is not so exquisitely ready, between 2. parts
assigned to Move, and they for some time cohere,
soe wee Not see, much coherence of body's? But If
they are so constituted and a force bear's hard to
part them that force drives y^e^ Smaller matter, apt
to accomodate y^e^ devision; so this very Case gives
us some light In the explanation of Continuity

And as to y^e^ other, of paralell space; It is Most
true

Absolutes & Relatives. 1

I doe not know any subject matter Relating to a
true Judgment of Naturall things /more obnoxious to most pertinacious p^r^judice\ then
this of absolutes
& relatives; therefore I Intend to bend all my artile=
ry against them. It is a Notion of y^e^ vulgar, that place
is a most stated sure thing, as Is their church Steeple,
and If all y^e^ world sunk into Nothing, yet here and
there would be the same. And the like of Motion, ffor
altho In different Respects or Relatively, things
may be convertibly said to Move or Rest, as the
chaires and Stools of a Cabin of a Ship under Sail
are Sayd to be a Rest, and y^e^ Men walking there to
Move, yet there is absolute Motion without Rela=
tion to any /stated\ thing ~~or place.~~ And No Wonder, If there
be absolute ~~Motion~~ place; there must be absolute
Motion, that is, from one abSolute place to another.
And the like of time, for all hang upon one String, they
Say there is a duration absolute, w^ch^ would Remaine
If all y^e^ substance of body In y^e^ world, by y^e^ Movemn^ts^
of w^ch^ onely, wee perceiv time, were annihilated
~~yet~~ And that 'fore and after continues of Necessity,
and all Engaged with body. These I say are the
opinion's of the vulgar, but however Great philo=
sofers, and cheifly S^r^. Is. N. thinck fitt to Maintain
them, I conceiv it is from y^e^ Same force of p^r^judice
In ~~them , as In the others~~, /all\ but it is so deep Rooted
In humane nature, that philosofy is too weak,
and If tainted with popularity Not Willing to Remove it.

2. Absolutes & Relatives.

That w^ch I hold is, that If wee abstract all body, and
our owne for Company, so as It ~~may~~ might truly b[e?]
said all body were annihilated, there would Remain[e?]
Neither place, space, time, magnitude or any other
[marg][293] thing whereof wee have any Idea thro y^e Means' of
Sence. first In generall I ask, What is ~~Say~~ /to be\ alledged to
the Contrary of this? They answer, that No Mortall C[an?]
Imagin, but there must be space, tho Empty; No Ma[n?]
Can Imagin but there must be time, & so forth. I ap=
peal first to the alledger, If he know any reason
to say so, but onely that he Cannot Imagin otherwi[se?]
And Next, If he thinck /it\ ~~that~~ a cogent argument,
that becaus he Cannot Imagin otherwise the thing
must be so? or that the Nature of thing's, Must wai[t?]
upon our Imagination. It is Most certein the trut[h?]
of y^e Matter, hath Nothing to doe with our fancy, &
let that run any way, y^e truth is unmoved. but W[e?]
have that Invincible p^rjudice as holds to an opinion
what wee thinck Impossible & y^e Contrary is so. Wee
doe Not Consider wee have No opinion borne with[in?]
It is onely a collection wee make by y^e Experimen[t?]
of things naturally occurring to our sences, & there
making Impressions. And If ~~and~~ an Idea be propos[ed?]
Contrary to one the sences have possest us with,
wee Immediately Reject it, becaus wee Cannot
Imagine such a thing possible. as wee live In a[n?]
open world, and have a view of y^e univers, and loo[k?]
upon the spaces abroad as Never failing Essences,
and never had y^e least Notion, of all Space being
anni

[293] marg: 'Space.'

Annihilated, and If wee force our thoughts, as a sort
of closing our Eys, to abstract space, It Instantly Returnes
as an opening of our Imagination, to conceiv the
Extension of Space, & cannot Shake it. What is it wee
have this Idea from? It must be answered, body. how
so? becaus it is Extended. What is Space? y^e^ distance
of body's one from another; how doe you Measure
it? by body, w^ch^ is, or may be in it. Thus In short
all our Notion of space is but a Notion of body, &
y^e^ Extension of it. And I defye any one to say he ever
had a notion, of space, but by y^e^ Mean's, or Measure of
body; Nay, Not of any measure whatever, but that
of Extension. doe Not all our Ideas come into us by
longu, latum & profundum? Wherefore then Should
wee Conclude that, space, w^ch^ In our Intellect, is y^e^
same as body, whatever wee pleas abstractedly to
affirme to y^e^ Contrary, Must subsist as of Necessity, tho
all body In y^e^ World were away.

But then let there be Space; that must be Infinite,
I deny there is any here or there in it, but onely
Relatively, that is Respecting somewhat or other,
~~man~~, or o^r^ owne person's w^ch^ wee take as a Mark
to declare from, or Relate with. ffor suppose but one
body In space infinite, it is all one where it is,
Nothing can be affirmed of it differently from
scituation, but still it is In vacuo Infinito, and
that's all. S^r^. Is. N. will affirme otherwise, that
there is absolute Space, and so will y^e^ Rabble,
but neither give a reason, but that None Can Imagin &c.

4. absolutes & Relatives.

so for Motion, If a body be Solitary In vacuo Infinito
(I comply with y^e notion) can any one Say, that Such
body moves, or Rests. I know set a mark, as o^rSelves
for Instance, taking an Imaginary Station. then wee
say it moves, that is Relatively to us. for wee Can
affirme /that Either\ it touches us or Not; y^t it is distant so Many
of its extents /That\, Now one side, then another is to us.
but Abstract all Marks, then Nothing /of all this\ remaines, &
None of these affirmation's, are true; but It is all one,
/whither you\ fancy motion, or Not Motion; there Cannot be an
affirmation of ~~any thing~~ /~~of~~ chang\, ffor that w^ch Never alters
is allwais y^e Same. I know Now y^e words are ready
that this is but a Cavil, or a Caption; as a sceptick
might argue ag^t his owne Essence. but I hold mySelf
to /this\ that where is No chang, is no Motion, And folks
Imagination Shall not with me Create Essences, ~~that~~ /w^ch If you\
remove y^e Imagination, are to all Intents, Nothing.
Therefore Cartesius carefully put into his definition of
motion, tanquam Quiescentia, however the latter
Caretesio-mastix Quarrells it.[294]

But now I have to doe with him, who is No slight
adversary. ffor In his principia, he affirmes with a
positive assurance, that there is motus verus, different
from moto Relativo; and that It would be so In
vacuo ~~Infinito~~ /Immenso\, and have active force, with out any
Relation; and that this motus verus, & motus Rela=
tivus (for such must be admitted) are Something
solitary & somtimes, & for y^e Most part mixt

[294] i.e, 'as, or when resting' (*Principia Philosophiae*, Elsevier, Amsterdam, 1644, II, 25, p. 53); '*mastix*' means 'scourge', so '*Cartesio-mastix*' means 'scourge of Descartes'.

And it is hard to discover w^ch^ is one, & w^ch^ y^e^ other
(so alike are they) but however doth not despair
and profers an Experiment of bulletts In a string
tyed to a stick, and turned about that as an axis,
untill y^e^ bullett's Receding from y^e^ Center draw out
the strings to a strait tension. so that one side
of y^e^ bullett struck shall increas the tension, and
the ~~opposide~~ opposite side /struck\ (that is stopt) shall slake
y^e^ tension, w^ch^ would be y^e^ same In vacuo Imenso
If no other body were In rerum Natura,[295] to Relate
too. And he hath another Experiment of a pail of
water suspended, and turned till the string is hard
twisted. then y^e^ water being perfectly stagnant in
the pail, It is let goe with a force y^e^ other way added,
& then violently turning downe y^e^ water at first Will
be flatt, till y^e^ pail hath drawne y^e^ whole body, as
it doth by degrees Into y^e^ Same gyration with it self
then It begin's to rise at the sides & dish in y^e^ Midle
w^ch^ Continues, and will be more or less as y^e^ turning
is Swift, altho all Relative motion between the
pail and water is gone. so, says he, turning y^e^ pail,
or If y^e^ univers turned about y^e^ water, w^ch^ is a Rela=
tive motion of y^e^ water. yet It shall not Excite a
Recess from the Center, w^ch^ is Motus verus, without
active force Imprest on y^e^ water; And so Concludes
Cartesius, tanquam Quiescentia, and error, ffor it
must be vera Quiescentia, w^ch^ define motion. And
he say's, this Recess from y^e^ center of y^e^ Movem^t^ is
allwais

[295] i.e., 'existed'.

6. absolutes & Relatives.

Allwais reall motion and Not Relative. W^ch^ Notion
ffor y^e^ better knowledged, must be Referred to y^e^ au=
thors words, w^ch^ are exquisite & nothing Els will Ex=
press his thought with advantage.

Now that all this is error, In so Great a Geometer
who should well to his principles, I must Not say, but
If I can, shew.

1. It is a Riddle that there should be In Motion
both something and Nothing, and yet as like one
and other as two peas ffor a buttett driven by a
wonderfull Explosion, Issues at the mouth of a Canon
and Rends y^e^ air with an Incredible fragor & force.
Then turne y^e^ tables, and let y^e^ air come against y^e^
bullett truely resting, as If it Were let downe from y^e^
Sky's Into y^e^ Earth's and airs diurnall ~~motti~~ Motion
as swift as y^e^ other. Then is y^e^ air Rent with y^e^ Same
frager & force as before. And yet these two cases are
Not y^e^ same; the bullet hath verus Motus In y^e^ first
and Nothing but Relativus in y^e^ other. while all the
symptomes, & effect's are Exactly y^e^ Same. And those
supposed. /And\ That it is scarce possible to discerne the
real from y^e^ Relative motion, as he say's, ~~that~~ It is as
I sayd a ridle to Make a distinction between them. but
this is Not argument, the Experiments must be ans^d^
and those I beleev he accounts, and really holds for
demonstration.

2. As to the turning pail, & y^e^ other also of y^e^ Globules
as also all turning motions whatever, I must
[~~avowe~~?][296]

[296] The paper is very darkened on the RHS of the sheet, and especially at the bottom of the page.

from Whence onely he hath a colour, (ffor the Rect-=
linear movem'ts are by No mean's to be used to his
porpose, but most manifestly & In all Respects Relations
I am to observe, a difference between motion and
the direction of motion. That the motion or Not Mo=
tion depends wholly on Relation, and may be Either
motion or Rest. but the direction's of Motion's that
is the path's or lines upon wch they Come neerer or
depart asunder are as reall & true as Extension it
Self. As let but 2. body's be in ye world, & these ap=
proach, whither one ~~or~~ /or both shall be sayd to\ other moves[297] is In the arbi=
trament of such spectator's as Shall be Introduced
to behold them. for If one hold distance with them
ye other, yt Changes moves, If ye other holds ye former
move's, and If both chang with ye spectator's both Move,
This is the Relation. but all ye while upon ye line or
path of ye access, there are really all degrees of exte=
sion, mensurable by ye Quantity of ye body's, as 3.
4. or. 5. diameters distant, and the like. and this is /fixt &\
true & cannot be altered, disq~~q~~guised, Nor Confounded
as the other's are; but will be & is ye same, Whither
Spectator's or None are prsent. Therefore I demand as
a maxime that whatever as to ye Reall or Relative
is determined of Motion, the direction of it, is fixt &
certein, and is not at all perplext or devided, as
he would have Motion to be, with any Relation.

3. Then.

[297] The 's' appears to have been washed out.

8. Absolutes & Relatives.

~~2~~3. I deny that there is any tendency from y^e^ center of
a turning motion, upon any other principle, then such
as governes In all cases of collision of body's; and I
also deny that body held in compass Motion & let
goe must Necessarily goe off in a tangent, but by
accident such as direct's y^e^ Movements on all Impulses,
but that it happen's so most frequently, I Grant. but
The Recess from y^e^ Center proceeds from a direction In
a strait line, w^ch^ Every Impuls, Such as y^e^ Cases on a
discharg, or freedom from a Compass motion are; for Ev=
ry Rectilinear direction, Must at length depart from
any point assigned. for these matters I Referr to the
places where they are proposed.

4. Now there is this Important difference between a
Rectilinear & a Compass movement. ffor In y^e^ former
all the parts have the same direction and Swiftness,
but In a compass, they have Neither. ffor lett loos,
Every part would move in a Severall direction,
and No two parts (unless In y^e^ Same circle) with Equal
swiftness. Therefore the Relation of /the parts In\ a Rectilinear
movem^t^, Is /all alike\ with y^e^ Circumjacent body's, but of a
compass, with each other, and all with y^e^ center
of y^e^ movement. In a Rectilinear, If It could be Con=
trived, let y^e^ parts be Inspired with a direction as from
a center, & lett loos, they would move accordingly
and also draw that way. The same thing is Inclu=
ded In the very movement In Compass, that the
parts

parts have various directions, and swiftness; then
what Els can happen, but that when free, the Same
Should take place and the Movem^{t} Consequent proov
accordingly.

5. Now the Reason Why, If y^{e} whole world moved round
y^{e} body of y^{e} water, (for y^{e} pail that Conteines it
turning is the same thing) It would Not Excite a
Recess from y^{e} Center of y^{e} water; and yet one y^{t} Swam
about /with\ the Rest, would Swear y^{e} water, & Not y^{e} world
moved; as In y^{e} first sollar of a win'mill, turned about,
all that know y^{e} Contrary true, would almost swear
y^{e} post & not y^{e} mill turned. Here it is to be Noted that
onely the surface, or rather totum of y^{e} water is con=
sidered, and truely. And Such Relation Shall never
excite a Recess from y^{e} center, becaus that moves
from another Relation, Namely between the parts
one with another, and of all to y^{e} center of y^{e} Motion
upon account of their /motive\ direction. If y^{e} water were a
Solid that is one Coherent body, I say still y^{e} Motion
is Relative wholly to y^{e} Circumjacent body's, and
arbitrary to be charged here, or there, as you are
pleased to Referr, and Esteem y^{e} Rest to Reside.
But so soon as you devide that one and make
many of it, w^{ch} is done by letting them loos, then
a New Relation spring's, w^{ch} will alter the scene.
So you Judg of a Ship steming y^{e} tide, Referr to y^{e}
water, & it moves, to y^{e} Ground (perhaps,) & it Stands
still

10. Absolutes & Relatives.

Still, and to ye Starr's, it moves againe. and you May
as well argue the Shipp to Stand and Move both, as
argue a force more actuall In a turning ~~or~~ /then in\ other
Motions; or Say that a Relation to ye center and of
the part's one to another, did Not produce a fresh
account of ye Movem't, as Referring ye Ship to ye Ground.
Therefore Sr. Is. N. was In ye Wrong to bring upon ye
Stage a parcell of many and loos body's, and from
the relation of them, one to another, argue a verity,
wch is Not drawn as well from other Relation's, as that.
ffor ye water in ye pail is Not one body, but consists
of as many severall, as by their distinction or Se=
paration, Constitutes ye fluidity; And is a case of ye
same Nature as If (gravity abstracted) a round Is=
land of Stones Should be turned Swift about, the force
beginning at the Center; and with Such efficacy
as Should Impress motion In all the Rest; certeinly
they must tend outwards, by striking one and other
till those within Influenced those without, & then
Every one march strait In tangents. So If the Island
were a vessell of stones, and turned round In that
manner, as In ye Experiment of ye pail, the rable
of ye force would by degrees pass frome[298] one Stone to
another, downe to ye center of ye motion, and the
Stones heap out-wards, and (wch shew's ye Reason)
annihilate ye fence, or bonds, and Set all free, and
Every stone will have his cours apart, with Relation
to Each other, and ye Comon center

[298] The 'e' appears to have been washed out.

~~11~~.

So is the Case of the water that is Not to be conside=
red as one body, for then there had bin No Relation
but (as I may say) one, the Exterior's, but it is an
aggregate of divers, & those Not Connected but free,
and all having a severall Impression & determina=
tion. So there Emergeth another Relation, by w^{ch} their
directions have a different Caracter. But to be More
Explained in this matter.

<diagram> let y^{e} body's A.E.F.G. be deteined
In a spherical movement on y^{e}
center C. So have severall ve=
locity's according to y^{e} semidi=
ameters. C.D: C.E: C.F: &
C.G. and let the lines, D d:
E.e: F.f. & G.g. be in the
same proportion as y^{e} Corres=
pondent Semidiameters. then I say If these all
let loos In y^{e} posture C.G. & moving in strict tan=
gent's the celerity's will be In y^{e} same proportion.
So y^{t} when G. is at g. F. will be at f. &c. And this
case is upon Every semidiameter of y^{e} whole circle.
Then is Not here a Comparative swiftness, as well as
direction of all the parts, w^{ch} being loos, Smite one
and other with force, as other occurrent body's doe,
when y^{e} Stronger p^{r}vailes? The Consequence must
be thatt all with these unequall celerity's In y^{e} pail
must have a p^{r}valency accordingly, and where is any
yeilding, as the force of Gravity. doth In some measure,
shew it by rising about y^{e} Sides, & dishing In y^{e} Midle.

And so ye Recess from ye center be marked by d.e.f.g, &
In yt proportion. If all the body's D. E. F. G. moved
with Equall Celerity upon the lines. D. d: E. e: F f: &
G g: then this Relation ceast and ye movemt was
according to other Relation's, as a single solid, of
wch I defye any Invention to shew me any Reality
In Motion but ye Relation.

6. Suppose upon ye center. C. ye Circle truely Resting there
Happened an Euripus or Whirlewind, and the bodys
D E, F G. were in ye way of it. In that truely Resting pos[=?]
ture. and being carryed Round In ye Euripus, once or
twice, at a Returne to the same the Euripus ceased. the
body's would proceed In those very direction's and with
the Same difference of celerity as before. so where an
Externe force can come at the part's it is all one, Whither
the body's are turned on a center, or carryed about
so that In that Case it is meer Relation, as upon Com=
mon Impulses. but If an Externe force doth Not cre[a=?]
te this difference of direction, and swiftness among
the parts, as the Case is before the motion is conveyed
from ye Sides of ye pail to all part's to ye center, the
Effect of These differences Cannot appear, but onely
a Relation between ye pail and ye Water, Considered
Not as many but as one Combined substance.

I cannot but be amazed, when an author of this
Exactness and distinction, Should Argue against Relation
when his very Instances prove it. As here his Instance
is of myriadds of body's Related In divers circumstance[s]
wch have an Effect Resulting, and he states /it\ as of one

body Related to another. Then his next is more No=
torious, And that he supposeth will hold In vacuo Im=
menso, It is of y^e^ Globules tyed to a stick and turned
round. I ask If there be Not. 2. body's that A Globule
and, the stick, and then a. 3^d^. to observe them. What
is this but a Relation of. 3. things one to another. but
take that away, and say that y^e^ Spectator shall Move
Round as the Globule doth, and there is onely
y^e^ Globule & y^e^ Center, w^ch^ I Grant shall stretch y^e^ string
by vertue of y^e^ Recess from y^e^ center. And that is Resol=
ved by, that w^ch^ I first Noted, It is y^e^ Rectilinear di=
rection, that is a departure farther in distance
(w^ch^ is all wais Reall) from the center that stretches
the string. As A. the Globule, & y^e^ String. A.C. the
<diagram> compass motion C.A.B. The Globule
A. In y^t^ point is in y^e^ same Condition
as to the direction, as If it were Struck
from. E. that is /to be\ driven towards. B. w^ch^ tends
to Draw the string A.C.~~B~~. to the length C.B.
And this Repeated In Every moment of y^e^ Circle of y^e^
motion. C. D: so It is Not y^e^ motion that is Real, but
the direction, (or Increas of Extension) that is reall,
Every thing Els, would be y^e^ Same according to the
Relation. As If A.C. were a batoon, & Not a flexible
yeelding string, and y^e^ Spectator's moved Round
with it all y^e^ p^r^tended Motus verus vanish't. And as
to /the\ tendency /without liberty, that is Nothing. but If freedome there
would be something, without it /Just\ Nothing.

14. Relatives & absolutes.

Therefore on y^e^ Whole , I conclude, that In Rectili=
near Movement's, there is No colour of essence In
Motion, but by Relation, for as I have sayd, or Must
often say y^e^ Motion & Rest are Meer arbitrary's, and
Subjected to Regards at pleasure, Either to be or
Not, or being, to be any thing. And as to Compass
Movement's, w^ch^ by accident, and No Intrin/=\~~cisk~~
Sick vertue, recede from y^e^ Center, there is Nothing More
reall or true in them but direction from the center,
w^ch^ preceeding open's distance, and so is apparent,
and so farr as things yeild, that hath Effect, & so
Shew's a tendency; and Such direction is Equally
Reall between all other Rectilinear changes W^t^=
Ever. ffor however you dispose of the motion by
Relation's, to Shew it more or less or Nothing, the
degrees of access and departure of body's Is At No
ones discretion, but the Same Identically & by Mea=
sure, as nise & constant as Extension it self.

[marg][299] Now as to the Conceipt, that Mathematicks & philosofy
are confounded, by this Indistiction of thing's from their
measures: first as to motion it self, w^ch^ I make to Con=
sist in Relation, is Nothing really, and it /is\ Extension
onely that makes the account. for hath Not More
Quantity more force, is not more & less onely Com=
parison /y^t^ is Relation of divers things\ and when wee assigne any magnitude
it is but Respective to somewhat Els /that is under some measure\ then Is Not
Swiftness meer Extension, that is comparison of Spaces

one

[299] marg: (in tiny script) '[motion?] no Subject of Math. but direct.' (i.e., 'direction').

one with another? how then is there any thing to
be knowne Concerning motion but Quantity, and the
direction In y^e^ Changes y^t^ happen to it. but that w^ch^
Confounds both mathematicks & philosofy, is the
assuming fals principles, as Motus verus, distinct
from the Relative. And when the Essence is Extension
or Quantity, that is measure, to say y^e^ Measure is one
thing, & y^e^ Essence another and Not say what. As in
the practise of Arithmetick. Numbers are y^e^ Measures
~~of the things~~, shall it be sayd, that there is In Number
[marg][300] an Essence, w^ch^ ought not to be Confounded with y^e^
measure; So Geometry is y^e^ Science of Quantity, and
accounts by More & less In certein proportions as things
are Rationed one to another. Shall they Say Quantity
is an Essence, and y^e^ Extension onely a measure? then
say what that essence is.[301]

As when the distance between A. &. B. is y^e^ Subject, is
it reasonable to say If wee doe Not sever the thing
from y^e^ measure of the thing wee Confound science?
Therefore wee thinck it is the buissness of the philosofer
to Reduce thing's home to their true Essences, and pare
of the Error's & p^r^judices y^t^ vulgarly Sitt about them,
And then deliver them over to y^e^ Mathematician to
Calculate as they pleas. But If y^e^ Mathematitian's
will p^r^sume principles, w^ch^ are y^e^ creatures of y^e^ Ima=
gination, and Not drawne as pure from Nature as
Is possible, and goe to work with them as Reality's,
build no better then those who Renounce phisicall
principles and yet, with Great assurance, make phisicall
conclusions.

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[300] marg: 'Dele' (i.e., 'delete').

[301] Shaded area crossed out with diagonal lines.

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16. Absolutes & Relatives

Now In a word, concluding this tract of true & Relative
motion, to doe right to Cartesius ~~fan~~ definition, against
This Invention of true rest, & true motion, I onely Repeat
that turning motion is objected, and urged to prove y^{t}
In turning the Recess from y^{e} center is a true Motion, &
Not Excited by any Relation. therefore Relating to
the vicinia tanquam Quiescentia,[302] is Not a defini=
tion of motion, but it must be really & truly Resting
y^{t} is absolute place, w^{ch} must define motion. to W^{ch} I ans[^{r}?]
that In the turning motion's, the center or axis, is the
tanquam Quiescent; ffor all the tendency's are Calcu[=?]
lated by distances from that, as all Relative Movemt^{s}
are calculated by the Comon distances. So Relation
takes place In turning as well, as in progression, where
it is as Good as admitted, Nothing being offered of ex=
periment but what Relates to turning.

Before I leav this head, I must take time in hand, w^{ch}
is held also in a sence absolute, and Independent on
body, so as Ever to flow equally; whereas all y^{e} Measure
of time as days. &c. vulgarly taken for the thing, are
unequall, & must be Reduced to equation, before any
account will fall right. This is the New p^{r}vailing acc^{o} of
Time.

I see not how y^{e} Notion of time Can be Received, but
Either as it is a consequence of extension, varyed In=
finite way's, by y^{e} Multifarious & continuing changes
of distance & position between bodys. As when 2. body[s?]
~~pari~~ approach a 3^{d}. and when one touches, y^{e} other is
In

[302] i.e., 'in a place of rest'.

Absolutes & Relatives. ~~17~~.

In y^e^ medium point, It is true to say that y^e^ one passeth
In half y^e^ time y^e^ other takes to pass. and So time and
velocity are all one, and Comparison of times, are but
the comparison of velocity's, observing coincidences
(& cheifly In circulars w^ch^ Returne) as marks or pe=
riods. And according to this Notion, time is Referred to
Quantity,or Extension measured by y^e^ Same. And their is
neither long Nor short absolutely, but onely longer or
Shorter, comparatively., As for Instance If y^e^ diurnall
circle moved round In half its time, and y^e^ Annuall
also In proportion, wee should know No difference but
day's would be day's and years years. And farther it
follow's from this way of accounting time, that If body
were annihilated, time would be No more; and Even
duration it Self would Ceas. As all Motion ceases with
body, And, In my concept, all space place & distance
also, but I know what a gigantick p^r^judice Stands up
against all this abstract thinking. ffor Say's one wee
cannot Imagine, but time must be tho wee are gone,
yes with those that stay, but whoso leav's body, &
hath no sentiments thro it, Nor (perhaps) knowledg
of such a thing as longum latum & profundum,
hath taken leav of all time, and duration, so that ~~all~~
'fore & after as to him are lost, and all things pervceiv~~ed~~/able\
are p^r^sent. I may be as positive In this as I pleas, for
Sacred authority is with me. but I proceed In argum^t^.
I must Never yeild, In this No More then in other abstact
matter's, that our facility or Impossibility of Imagination

ia any

18. Absolutes & Relatives.

is any argument for or against ye Essence of things
all wch Stand on their owne bottom, without leaning on
our fancy, wch wee know to vary In Numerous Respects
from thing's, and is a very Idol[303] to cheat ye vulgar.

But, say Some, wee mistake ye Measure for the thing.
I would be glad to know what thing is, for wch wee,
by mistake, take the measure. It is duration? What is
that? Wee know /say they,\ it is, tho wee Cannot say what; to
that I ansr In kind, Nothing. And I challeng any one
to give me his Idea of time, apart from his Idea of
comparative swiftness of body's in Motion. And therefore
some thing's, of wch time is one, depending on Quantity,
~~and Imagination~~ or Extension, wch have their Essence
/or at least all we can know, of it\ In Measure, when ~~some~~ philosofy hath Reduced it
to
that, must be consigned to ye Mathematitians, ye others
having done their part's, in cleaning ye Materiall
for them to work upon. This method, I thinck is Not
Confounding thing's, & their measures, or abusing
philosfy & mathematiqs.

The other Notion of time is from our sence or Idea
of it's succession and Continuance, and that is caused
by various object's of sence succeeding one and other
wch as all variety's distinguish ~~one &~~ /Each\ other, are observed
and give us ye Idea of time; wch also, tho Consisting
is devided Instances, yet, as pulses, (In themselves
devided,) make a continued sound, doe In out Ima=
gination so swiftly succeed that they create a
sence of fluxion or continuation of time. And this
After the Idea of body's Moving uninterruptedly.
All

[303] *See* note on f. 109r.

Absolutes & Relatives ~~19~~.

All w^ch I have more diffusedly noted, discoursing of
Human Capacity.[304] Now According to this Notion of
time w^ch is y^e truth, and what is philosoficall to Con=
Sider of y^e Subject, Nothing is more Manifest, then
y^e Mortality of time. ffor first It is no Stated thing
but sometimes longer, & at other times More breif,
according as the attraction is fast or loos. Wee ~~free~~
frequently thinck some hours longer then day's, &
that happen's upon acute paines, or other tediums
of life, when wee desire and End, it is Slow to Come,
and on y^e Contrary when pleased, & wee fear Nothing
more then a Conclusion, It comes, as wee thinck, sud=
denly upon us. This made a fantastick philosofer
M^r. Fairfaix, conceipt that perfect happyness, as In y^e
Diety, devoured time, & Reduced it to the scoolmens
nunc stans.[305] Then next It is frequently, as to say Nothing,
ffor In Sleep, trances, and strong amusem'^ts, it is all
one, as If time ceas't and began againe. ffor If wee
Had Not Information from others, the speculation
of y^e heaven's, or view of the automata of time,
and /had\ slept from sun rise to sun set, as beasts
may be Supposed, wee should thinck y^e Sun had
Not Moved but skipped from East to West. So that
time in out Imagination is Nothing but passing our
attention from one thing to another, & that is faster
or slower, with more or less content, time is Shorter
or longer; and Supposing us freed from all know=
ledg of body, there is like Reason to Conclude it Nothing.

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[304] *See* BL Add MS 32526, ff. 34v-47r.

[305] See note on f. 12v.

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<page blank>[306]

[306] Although unnumbered, this is clearly p.20 of the Essay on Absolutes and Relatives.

There Remaines one thing more, w^ch^ hath its Essence
In Relation, or rather Comparison, w^ch^ is Magnitude.
It affords as much of admiration to y^e^ vulgar, as
of puzle to y^e^ vertuosi, ffor Extream's are a subject
of wonder, to y^e^ one, and y^e^ truth a subject of dispute
and cavil to y^e^ other. ffor I have heard it most des=
perately disputed, how wee Could come to know y^e^
just and true magnitude of any thing, ffor as o~~b~~/p\tick
Glasses deminish, so our Eye alter y^e^ Image. And wee
doe Not know so Much as y^e^ true magnitude of our
hands, that handle things. And as ffor y^e^ other sort, tell
them of devisibilty In Infinitum, or of an hair upon
y^e^ Nose of a ~~Might~~ Mite, or 10000, animalls In a
drop of pepper water, they will not beleev it. so of
y^e^ Extent of y^e^ world, that a canon bullett with its Ex=
tream vigor as from y^e^ peices mouth, would Not arrive
at Sirius, or y^e^ Great dog starr, (as Mons^r^ Hugens Inge=
niously argues,) In 25,000. years, of w^ch^ y^e^ age of y^e^ World
In our acc^o^, hath Not spent. 4000. They admire and
Cannot beleev such Immensity on y^e^ one Side Nor devi=
Sibility & exility on y^e^ other.[307]

To shew how this p^r^judice ariseth from the knowledg
of our /owne\ powers, and substance, with Reference by compa=
rison to y^e^ ordinary thing's about us, of w^ch^ some wee
can, others wee cannot move; some are too litle for
any dealing of ours, & other's too bigg to be Comprehen=
and thereby wee make our Superlative opinion's, is to Re=
peat what was S^d^ of p^r^judice, So I waive that & proceed.

[307] These are all RN's familiar tropes of immensity and 'exility', and will by now be familiar through repetition.

22. Absolutes, & Relatives.

And that is to affirme a Strang proposition, but what
after ultimate thinking seem's to me to be ye Naked
Truth, that Magnitude No More then Space, Motion
or time, hath No Essence but Comparatively. ffor barr
Comparison, Every Magnitude is ye Same; And all ye
distinction is from Collating one thing with another,
My reason is that I doe Not know any one thing Can
be affirmed of any one body, that is Not true of Every
other, wherein I suppose ye figure ye Same, And /even\ that
is also but Relative /onely ye Relation is made Intrinsically\ to ye part's of ye body,
as ye Whole
of that Relates to some others, extrinsically. ffor If it be
a Globe, pyramid, cilinder, prisme, or any like figure
Say all yt can be sayd of all, or any other of like figure.
As Including certein Mathematicall property's, devisi=
ble Into as many parts, that is Infinite, capable to act &
be acted upon by equall's, lesser, or Greater body's in
certein proportions. and proportion allowed, to have all
the Caracter's of Greatness; or what Els can be Imagined
of body; And animalls, must thinck of Greatness, by ye Mea=
sure of their owne Greatness, and Every so seeming is to
to them really so; and according to this the seeming,
is allwais ye true magnitude of thing's. wee are Sensible
of this, ffor houses, Room's, & ye like were greater to us
when litle children, then when men, wee thinck them,
and after such Intervall of time, wee Cannot but ad=
mire the alteration. Nay Even time, hath a Share
of this Influence, ffor It really seem's Longer to chi=
dren then to men, as may well be since, the com=
mon measures of time, are to them Greater, then to Men.

Absolutes & Relatives. ~~23~~.

Hence wee may Infer it to be a vain dispute, as y^e^ Said
fantastick made of y^e^ bulk and selvedg of y^e^ world, that
is of Magnitude, and Infinity. ffor If wee may be So free
with our Imagination an limitt y^e^ world, as y^e^ Illiads, In
a Nutshell,[308] all thing's Shrinking in proportion, the Case
is accurately y^e^ Same to all sensitive being's In it.
As it is were /if all\ y^e^ knowe & unknowne Quantitys of y^e^
World, as the Mathematitian's Say, Multiplyed so as
to be Equall with any Quantity assignable; ffor all
thing's would appear the same. Therefore I can have No
other Idea of magnitude, but as a Comparable thing,
and bating Extension, w^ch^ Every body hath, be it Never
so Small, denominated, I may say made, y Compa=
rison, and that a part; All body's are but Extended
and Extension is y^e^ Same in all things, & consequent=
ly all thing's Extended are alike. And who ever falls
on me with the words more & less, lett them say really
or what they will, so long as y^e^ language is Nothing
but Comparison, w^ch^ Supposeth Somewhat Els Collated
It hath No effect on My reason, to Chang my opinion.

I Could (to Conclude this discours of Relatives)[309] wish my
self an orator, to Rep^r^sent with some dignity, the Super=
lative of the wisdome of the worlds creation, in this one
single Institution of Extension. This meer longum latum
and profundum, W^ch^ produceth to us, and all sensative /beings\
/those\ Images wee have of light, w^ch^ gives us y^e^ Extent of y^e^
world, sound, w^ch^ shews us harmony & discord; And
powers, to shew us y^e^ Efficans and property's ~~of~~ /and\ wonder=
ful Excellence's Gathered out of it. W^ch^ be they ascribed
to thing's, are admirable, if to our sences, No less

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[308] This seems to be a reference to the Tabulae Iliacae, miniature carved marble tablets produced in Rome in the early Imperial period which related, in brief, Homer's epic narrative, combining both illustration and text in relief. The 'bulk and selvedge' reference is to Nathaniel Fairfax's book, mentioned on 229r, above.

[309] This last paragraph (extending over the page) appears to have been added as an afterthought, and is crowded into the space available.

So that turne us y^{e} way wee will Wee are surrounded
with wonder,

<red BM stamp>

232r[310]

Relatives 1

This is a strang & new title in Naturall philosofy.
but upon ~~weing~~ weighing some passages lately In print[311]
I thought it not Improper, being to lead a discours
of matter's w^ch^ have no essence but by mean's of Re=
lation to others; and this not in trivialls but the very
substance of this knowledg. ffor it Comprehends the
true notion's of Magnitude, space or place, motion, and
time; about w^ch^ it will be necessary to argue a litle Me=
taphically, becaus of the great abstraction must be
had of all manner of ordinary thought and opinion.

1. As to magnitude, it is /a thing\ Setled, that all body, or (If
you pleas) Space circumscribed, is ~~a thing~~ certein and
of it self existent, without dependance, or Relation to
any thing Els. but adding /to that\ great, small, more, less, &
y^e^ like, all w^ch^ are comprehended under y^e^ abstract word
magnitude, nothing is understood, but comparison,
& that is nothing at all, without somewhat with w^ch^
The comparison may be made; And for that Reason,
without more, there is No absolute magnitude; w^ch^ pro=
position hath bin maintained In disputes, with more
reason, then comonly is attributed to it. And particularly
this, that /(comparison apart)\ there is nothing true of any one body ~~(com=
parison apart,)~~ but y^e^ Same is true of all ~~y~~^e^ /other\ body's In y^e^
world of y^e^ Same figure. ~~that is~~ /vis^t^.\ devisibility In Infini=
tum, and ~~all~~ /y^e^ ordinary\ Geometrick propertyes ~~of ffigure~~ /~~y~~^e^\, & ~~all~~ o=
thers ~~property's~~ if any be. ~~Any~~ state what magnitude
you

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[310] The whole of this essay, which runs to f. 239v, suffers from the same chalky-white marking described above (f. 12v). The paper is also badly marked by dust.

[311] i.e., Newton.

pleas with its Caracter of Small, great, or ~~even~~ Immens
it is all destroyed by the Caracter of what may happen
to be Collated with it, If it Inclines more foreward In y^e^
Same progression. W^ch^ consideration Makes me Reflect on
y^e^ vanity of those who Conceiv an Idea of /of admiration from the\ Immensity
In y^e^ World, w^ch^ Idea proceeds /meerly\ from y^e^ Exility of us Reptiles.
as a comon tree is a small thing In our view; to Some
Insect's (If wee saw with their eyes, & measured with
their steppes, wee would pronounce) it is an Imens region.
And ~~as as larg as y^e^ World seem's to us~~, (giving way to those
who thinck it /y^e^ world\ ~~is~~ limited /as larg as it seems to us\), If It were
contracted Into the Com=
pass of an Eggshell, everything deminishing In proportion
the case would be y^e^ very same as Now it is, ~~and~~ /wee but supposing\ the Egg=
Shell were magnifyed /so as\ to become its limitts. But the
p^r^judice, w^ch^ obstruct's this way of thincking, and ~~sti~~ sitts very
fast in many men's minds, however capable /they are\ and stri=
ving ag^t^ it, /And\ hath /violent\ Influence on their opinion's, and makes
them partiall. ~~as ffew there are but fancy~~ /is a certein conceipt they have of\
somewhat
more lofty and peculiar /belonging\ to y^e^ planetary Courses, then
to small whirlepools, In a creek, or brook. and /such\ are loath
to have those Great things discourst, as having analogy
with Small ones; nay scarce bear it, without passion;
And this is one reason why the Corpuscular hypothesis of
Nature is so hard of digestion, becaus it hath but one rule
or ordinance to direct both the cours of water & earth
In a Kennell, and of y^e^ planets. but /men\ choos rather /to\ Invent /~~for their~~\[312]
for their /sakes\ somewhat Extraordinary as If their dignity Suffered
in

[312] The words 'for their' is washed out.

Relatives ~~3~~

in being Ranked with common things

2. The next matter under this head to Reflect on, is Space
by w^ch^ is meant that room in y^e^ world, w^ch^ one sort of
philosofer's, say is perfectly filled with Impenetrable
body's, and another sort say, there are /(its true)\ many such in
it, but that is, for much y^e^ Greater part, perfectly void
of body. And these latter distinguish between space abso=
lute, & Relative; the former immovable, and y^e^ other
attendant upon Systemes of body y^t^ Move, as when a book
is lay'd upon a shelf In a caban of a Ship under sayle,
that place changes with y^e^ Ship, but is y^e^ Same as to y^e^ Rest
of y^e^ Caban. This matter is layd downe, with y^e^ Rest, at
y^e^ beginning of y^e^ principia. It doth not appear whither
y^e^ author ~~admitts~~ /holds\ y^e^ world as /to be as\ to space infinite. If he doth
suppose it limited, then space is fixed, but still with Re=
lation that is to y^e^ limitts, as neerer this or that Quarter.
But If he allows Space Infinite, I doe Not see there is such a
thing as absolute Space. /If it may be supposed that one onely.\ but If but ~~one~~ thing
were in y^t^
Infinite Space, the difference of here or there is Not extant,
ffor be pleased to fancy it here or there, all you can say
of the one is true of y^e^ other. Wheres then y^e^ difference? And
Nothing can fix a position, so as a body may be sayd here
or there, but ~~by~~ /the\ p^r^senting some other body, and then Emer=
geth a Respect of distance and position between these two.
but taking those two, or any Number more together In
systeme, setting aside those Reciprocall Respects; but com=

=pre

=prehending all In one thought, that compound totum
hath No determined place but all arround is Equally
Infinite, whereever p^{r}judice suggest's it to be. And things
that are all one, I thinck are not divers; & so is place w^{ch}ev[er?]
Relation, In vacuo Infinito. But one may say, be two body['s?]
onely in y^{e} World, and Mark their places. let one come
neerer y^{e} other by half y^{e} distance; & then let that other
be annihilated; will that moved be in y^{e} Same place
It was in before? I Answer that /by force of Imagination\ here the memory passeth
for thing's ~~In y^{e} Imagination~~, as If they Existed; ffor y^{e} first
place of that w^{ch} moved, is Remembred as /it was conceived before,\ full. and the
length moved is Remembred, and all 3. Subsist in our
minds & make an idea as of a Systeme continuing.
Therefore unless the Remembrance be Quash't, as well as
y^{e} body annihilated the case is not stated; & then it is
y^{e} Same as before.

But In this Reflection Concerning Space or place, Wee
find one thing very certein, and that is The Sphear
/of space Infinitely\ round any body /that wee\ can ~~be~~ conceived, and ~~If it be~~ /Such
body\ Reduced
as small as to be next to an Imaginary point, It is the
center of such Sphear /~~extended Every way~~\ ~~ad Infinitum~~. So that If Nothing
Els were in y^{e} world, the Exterior part's of y^{e} body have
all their regions of direct aspect; and /to Instance\ the aspect if
that side y^{t} is to y^{e} East, is Not y^{e} Same, as of that to y^{e}
west, ~~for Instance~~. And however the place of that body
may be counted Relative or absolute, the Sphear of
its

its aspect's is Ever certein, and depend onely on that
body, ffor iti is considered with Relation to the center, from
w^ch^ lines are Imaginable to issue Every way ad Infinitum,
& Each line is different from y^e^ other.

3. The Next Case is, Motion w^ch^ that author holds May
be Either true, or Relative; the latter is decyphered
by a ship sailing in a Current, & a man walking on y^e^
deck with /a\ watch at work in his pocket, & all y^e^ while
y^e^ Earth moving diurnally & anually; whereby some
body's may be sayd to Move, or Rest, according to y^e^ Rela=
tion, as it is had to y^e^ Ship, Earth, fixt Starrs, &c. but true
motion is Referred to absolute space, & depends on that.
And this distinction of Motus verus & Relativus, w^ch^ is
owned very hard to Experiment, yet is Endeavoured to
be proved by an Experim^t^ of a pail ~~with~~ /of\ water, turning.
w^ch^ before y^e^ water is in motion gives No signes of y^e^ Waters
Receding from y^e^ Center, and yet y^e^ Motion between y^e^ pail
and water Relatively is perfect. but When y^e^ Water
hath contracted y^e^ turning also, then y^e^ Recess beginns &
y^e^ water shall dish up about y^e^ Sides of y^e^ pail. And so
also Bullets made fast to string's & annext to a staff
or axis to be turned shall stretch y^e^ strings, ~~tho~~ /and this even\ In va=
~~couo~~ cuo; ~~and there~~ /where\, supposing no other mean's to know /that\
y^e^ body moved, it might be discovered by stopping y^e^
bullets & then the string flagged, or striking to In=
creas their Swiftness, & then the string stretch't. this is
the

the sume of the distinction, & experiments.

But yet I cannot be perswaded but motion consist's
in meer Relation, and the distinction of true and Rela=
tive is no where, but In the fancy. ffor If wee consider
fairely, wee Shall find that There is nothing in motion
but what concernes more then one body, ffor it Consists
in chang of distance and /aspects or\ posture between divers
body's, and In Nothing Els. ffor when such distance
& posture continues y^e Same, it is called Rest, and when
there is any chang It is called Motion.[313] wherefore In
vacuo Infinito one single body can Neither move Nor
Rest, ffor /under y^t supposition\ the distinction is not ~~under that Supposition~~
Extant. The difficulty of coming at the Justice of thin=
king in these matter's, is wee cannot abstract our
owne person's, so as to conceiv a solitary body, or
pure Infinite vacuity; becaus frame our Idea as wee
pleas of any thing, still that of our owne selves, will
obtrude and make one, from whence wee fix a Relation.
But things do Not depend on our way of fancy or
thincking, and wee must wholly discharg Nature of
that Incumbrance, If wee will know any thing /Justly\ of it.

Then It is to be considered, when once wee have
an Idea of divers body's, of whom our owne Comonly
makes one; there is that I call a systeme. and Not
onely y^e body's but y^e Space Intermediate & Circum=
jacent is taken into y^e systeme, and by the chang

or

[313] RN writes the word 'Motion' in a larger script, giving it emphasis.

or Continuance of that Systeme, wee pronounce of Motion
or Rest. But wee being, In our Natures limited /with-\in Nar=
row bounds, and not /capable of\ Conceiving Much together, ~~but~~ /& cannot\ Ex=
tend our Imagination of Greatness, & Immensity /otherwise then\ by Re=
~~peated~~ /petition of y^e^ Same\ Ideas (for an Idea will Contein No More then wee
can sensibly conceiv at one time) It happens, that /In our Imagination of motion\ Wee
pass ~~In our Imagination of Motion~~ from one Systeme to
another, and Cannot Comprehend at once, the Systeme
of y^e^ univers. and for that reason, after wee have by
one systeme of body's Conceived a motion, If y^e^ fancy pass
to another systeme, that /w^ch^ was motion is none\ ~~is No Motion~~ but Rest. As a
Ship under sail with a full Gale, ag^t^ a current, w^ch^
is as stiff as y^e^ Gale. If you Respect the strife between y^e^
ship, and y^e^ water, with y^e^ wind that drives it; there is
motion; but If you Respect the ground, it is Rest; &
Respect y^e^ diurnall motion of y^e^ Earth, there is one Motion
and y^e^ annuall another, And If you Could have an Idea
of all thing's /In y^e^ world\ together, w^ch^ onely y^e^ Almighty can, I p^r^sume
not, to say what caracter motion would have. but ffollow=
ing our nature, as to the possibility of Conceiving, It is so,
that as wee extend our Regards, motion is something, or
nothing, this, or that, or any thing, just as our Regards
supply measure, or standard, whereby wee are pleased to
Judg; of w^ch^ the Example of y^e^ Ship is Sufficient.

Cartesius thought thus when he framed his definition
of motion[314] to be a translation of body's from neerness
of

[314] See René Descartes, *Principia philosophiae*, Elsevier, Amsterdam, 1644, II, 23-35 (*see* http://la.wikisource.org/wiki/Principia_philosophiae). For an English transcription of the text *see* http://www.earlymoderntexts.com/pdfs/descartes1644.pdf

of some to neerness of other's, considered as Resting. The
late author's Quarrell to this ~~distinct~~ definition is, that y^e^
translation ought to have bin Referred Not to the, tan=
quam, but verè Quièscentià.[315] And at same time, he Say's
there is scarce a body in y^e^ world truely at rest, but Means,
as I suppose /that space\ must rest, ~~tho it were~~ /however\ Impossible /it is\ to find
it.
And therefore /that Supposed Resting space is,\ unfitt for a definition, for by all y^e^
rules y^t^ I
Ever read a definition ought to Contein some knowne pro=
perty, or that, with dilligence, may be knowne, and is
truley Incident to or goes along with the thing. then I
wonder how any one should know motion by a defini=
tion that Referrs it to Nothing, as /an\ Imovable peice
of Empty space, ~~at to all~~ /ffor that as to\ our Cognizance, is so. but ~~I am~~ /from\
~~by~~ not a ffew passages In y^e^ author, /I am\ Inclined to thinck that
If that definition of Cartesius, /w^ch^ is\ one of ~~the~~ /his\ best thought's,
were not of necessity ~~of~~ to be oppugned, this distinction
had Not bin held forth.

It Remaines to ans^r^ the Experiments, In doing w^ch^, I must
anticipate a litle /of\ what will follow, ~~from the~~ becaus the
cases of them are complex, and the rules of simple motions
should first be understood, before wee Come at these. But
Even that is an answer in some measure, that here
is a systeme of body's proposed, In Each experiment.
In y^e^ first y^e^ pail, y^e^ water, & y^e^ room. In the Next, the
staff, ~~and~~ y^e^ bullett's, and the string's; and a bystander
to strike or stop them. All these Make y^e^ case Not
so abstract aas it Should be. but lett all that pass.
His

[315] i.e., not to 'rest' but to 'true rest'. The reference here is to Newton's discussion of Descartes 25th paragraph (*Principia philosophiae*, Elsevier, Amsterdam, 1644, II, 25; s*ee* http://la.wikisource.org/wiki/Principia_philosophiae) in the Gereal Scholium.

Relatives. ~~9~~

/His\ Assertion is that Recess from y^e^ center, is a true Motion
and is neither made ~~nor~~ Qualified Not taken away
by any relation. [but?] is more or less, according as the
turning is more or less swift; The fact is Granted. and
I Reply with a distinction between y^e^ Case of one Intire
body turning, and a systeme of body's turning. If it be
the case of one body onely, I say Relation hath place
as Intirely, as in the case of progression. ffor it is all
one in Every Respect between the Earth (considered
as one thing) & y^e^ Sphera fixarum; /ffor\ Whither that or
this turnes /all consequences are y^e^ Same\. But If a Systeme of body's be in a turning
motion, It is to be considered that Each body hath a
Rectilenear direction, and will Not hold a direction
by a curve, without being deteined. And that Recti=
linear direction is Not Inspired by any Relation, but
what concernes each part separately taken. And this
Rectilinear direction is Not /with\ Equall swiftness in Each part
but the more remote from y^e^ center, are so Much More
swift. ffor this reason when this loos systeme is put
Into a turning Motion, the component part's proceed
In directum, and that produceth y^e^ Recess from y^e^ Center.
But the turning of y^e^ world about a vessell, doth Not
make y^e^ part's proceed directly, becaus y^e^ Relation is
to the whole, but Not to the part's severally. ffor y^e^
better Explanation of w^ch^, I propose y^e^ following sceme.
And In y^e^ Mean time, let it Not be sayd that y^e^ parts of
one body have a tendency In directum. ffor tendency
y^t^ is Not motion, is Nothing, as hereafter, may appear

let

10. Relatives

let. D. &. E. be a Systeme of body's
moved In ye pail A.B. round ye Center
C. and In the posture C.D. be at li=
berty. I say D. shall Move towards
F. and. E. towards. G. And If. C.D.
to. C.E. :: D.F: E.G. when D. is
at F.: E will be at G. And this is No More verus Motus
then If In the points D. &. E. those body's had /by any other Means\ that
swiftness /& direction\ Given them. As let D. & E. be free body's Resting
In the /open\ Medium /(as wee now conceiv it) A.B. in wch also\. A.B. ~~In~~ are 2. Equall
bodys /K & B.\ Carryed
about with ye Medium by. H. & A. and strike D. & E. the
case is ye Same, as to ye motion of D. &. E. Receding from ye
center, as if they moved round, & were freed In those places.

Now here is the same Relation ~~that is~~ /wch is to be noted\ In all cases of
Motion whatever. ffor first the severall bodys have a
Rectilinear direction, wch put's them In a posture & cours
as to distance Respecting Each other, and all the like
Respecting the center. And the Recess from ye Center is
consequentiall, and In ~~an~~ /the\ aggregate of a Multitude of
~~such~~ systematized body's, wch is ye Case of ye pail of Water,
(for Every part of ye water, being loos & free, is such) there
is a Complex Effect of dishing about ye sides. Wch It Could
not have /[till?]\ the parts had Such rectilinear direction given
them; wch None could say could be inspired by ye Rimm
of ye pail, wch affected them not but Gradually, first
those

Relatives. ~~11~~

Those Contiguous, & then by y^e^ Mediation of them others, ~~all~~ /untill\
at length ~~having y^e^ Same~~ /all come to pertake y^e^ same motion &\ direction.

The like ans ~~to~~ /is given to y^e^ Case of\ a bullet, about a Staff, w^ch^ is /partly free &
\ loos, and
moves in a right line untill curbed by y^e^ Cord, and then ~~by~~ /in\
consequence y^e^ Cord is stretched. Not from any more true Mo=
tion then in other Cases, but /as I sayd\ In Consequence of a Rectiline=
ar direction. But there is also a continuall Relation
to y^e^ center & the circumambient Sphear of space, w^ch^
Relates to that center, as Spaces In all other cases /of direct motion\ are Mar=
kable by Imaginary /paralell\ lines, and then /having\ Relati~~ng~~/on\ to those Marks
those Spaces are so farr /made\ certein; and therefore a Compass
movement ~~Relates~~ /is Relative\ to y^e^ center /of it\, and y^e^ Region ~~from w^ch^~~ /about it.\
And y^e^ chang is from one side of it, to another. So I deny
The Recess from y^e^ center to be verus Motus, or less Relativo
then any ~~of~~ other; but this may have farther Explanation.

But ~~this~~ /Here\ seems as /express\ demonstration /that\ Motus Verus cannot
be antrorsum & retrorsum[316] upon y^e^ Same strait line of
direction, and at y^e^ same time. for (as they say) it Referrs
to Imovable space from w^ch^ it ~~goes~~ /Either moves\ or doth Not ~~goe~~ /move,\
that is Rests. Then the body D. hath motus verus towards
F. w^ch^ is the genesis of its Recess from y^e^ center, all w^ch^ Recess
/(they say)\ is motus verus. Then I demand that y^e^ center. C. and the
Whole Systeme A.D.B.H. be moved vero Motu. from
B, towards. A. upon y^e^ line B.A: It follows that y^e^ body. D.
In y^t^ point. D. hath a double trew Motion, one /forewards\ with y^e^ Whole
towards. M. and y^e^ other /backwards Receding\ from y^e^ Center towards. F. . . . QEff.[317]
That is verus motus and vera Quies[318] at y^e^ Same time

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[316] i.e., 'forwards' and 'backwards'.

[317] i.e., 'QEF', or 'Quod Erat Faciendum', 'that which was to be done', the phrase is one he would have known since boyhood from Euclid.

[318] i.e., 'true motion' and 'true rest'.

12. Relatives.

But ye Author hath a farther discours on this subject to
be answered, ffor when he compiles Enigma's they are
Not Easily throwne downe. And it is a censure of a Miscar=
riage In philosofy, When the measure of thing's are taken
for the thing's themselves; wch he say's Confounds philoso=
fy, & Geometry. I Grant a man is much In ye wrong that
Goes Into a mercer's Shop, and asks for 10. yards, and Says
not /of\ what. but If he say's velvett, & agrees ye price the
~~practick~~ Geometrick yard Goes to work; ~~Becaus~~ /there\ the vari=
Ety's /of things as well as ye Measures\ are knowne; But If In a Measure makers shop
a man should ask for a velvet Measure, they would
laugh at him, or any thing but ye Measure it self by
name he wants; that is a 2. foot Rule or a yard. Wth=
out Regard to ye Materiall. ffor ~~there~~ /In that circumstance\ ye Measure /onely\ is the
Thing; & If men should talk of measures, and one ask if
this be /a\ true /measure &\, another say's tell me what ye materiall is
and I'll tell you /wee should Smile.\; Thus it is In philosofy. Wee have No
Notice of ye World, or of any thing in it, but under certein
Measures; and other account of ye Substance wee Cannot
give. ffor mutable property's are Not ascribed to body In
Generall, but ye Imutable onely, wch /are\ Extension, and Im=
penetrability. Then how can any one dicours of body
but according to its Quantum, with ye /modes &\ property's /that is Extension\ of
Quantity
/or Measure\ If the author knows more of the thing it self, then so; let hi[m?]
Aid ye philosofick world, & comunicate /it\; those Men are apt
to catch at discoverys. But Whilst the Measure is the
thing, at least as to us, that know no other, how doe we
con=

confound any thing by treating body by its measures
onely? ~~But~~ /And to say truth\ In these Instances I here Give, w^ch^ I call Re=
latives, there is Nothing Extant but Measure; ffor Mag=
nitude is Measure; and I pray what is Empty space,
but room for so much; that I thinck is Measure; and
So Motion, w^ch^ is Nothing but chang of aspect & distance.
ffor aspect it self is but More or less distance; and pos=
ture, I hope, is but a Relative also; And time W^ch^ I Speak
of Next, as a Relative also Is Nothing but Comparison
of measure. And whereas y^e^ author Say's, there is du=
ration or tempus absolutum, all body abstracted; w^ch^
is Not /as our time\ measured accidentally and unequally, by years
months, &c but w^ch^ flows allway's Equably; that is, I
thinck, Equally; I demand, Equall to what? I scarce
Thinck it possible, (abstracting body) to ans^r^. that Question.
But to conclude it is manyfest these Relatives, have po=
Sitive Existences /thus\ given them, Either from /vulgar\ p^r^judice, w^ch^ Makes
us apprehend, Gold, diamonds, & pebble stones, to be /all made\ of
a different materiall, and so attribute, as y^e^ use is, our
Imaginations, & fantasmes to things, or Els Somewhat
Must be sayd In opposition to Cartesius, who opened
the way, to this sort of Thincking; and of y^e^ two, I Incline
to y^e^ latter.

4. As to time, I take it to be a consequence of motion;
that is, In our conceipt, it is time, but In nature the same
thing as motion. so take away all ~~al~~ animalls that
perceive

perceiv onely thro ye Mediation of body, and Nothing is
left of time but motion. and take away all body, or ye
changes of it. wch is all one, and /then\ all time, and sence of it
is gone. so farr ~~doe~~ am I from admitting tempus abso=
lutum, that I thinck the Idea of time is onely in our
Imagination, and the thing, such as it is Is onely in Motion,
And those ~~of~~ /who owne\ ye Contrary opinion, Say /for it\ they know Not What,
ffor ask them what ~~it~~ is /this equable time\ and they give you /for ansr\ another
Word;
as duration; what is duration? Continuance, and So Wee
may goe over all ye abstract words In ye dictionary and
Have no other thought then is usually had upon pro=
nouncing ye word time. and It were more Ingenuous to
say wee doe Not Imagine it possible that time Should
ceas, but whatever becomes of all thing's Els, It seems to
us time must Remain. That this Conception is So, I rea=
dyly Grant, but the capacity in us of conceiving or Not
conceiving, is nothing to the truth of things. And It is No
wonder that our Imagination is so Engaged to a Notion
of time, becaus all wee know, or can possibly forme any
distinct Idea from, is Motion; and therefore wee are to
consider ye truth of that, and thence Extract the Manner
how it makes us sensible of that wee Call time.

It is /In\ ye essence of Extension to contein more, & less; and
that notion of more & less, is hardly had beside extension,
ffor take the comparison in number, and let ye subject
be angells or spirits that have No Extension; yet when wee
say 2.3. or more Angells, wee feigne places In Extension
for them

for them, and so it is, that our very thought of Number
is y^e^ same as that of Extension, & y^e^ Imaginary devisions of
it. And the same thought produceth Coincidences and sepa=
rations; ffor some body's may come to a period or touch, and
other's be at great, or less distance. and /all\ these things ~~be all~~ /subsist in\
in a /continued succession or\ Cours of changing; and /then\ wee /being\ capable of
marking y^e^
postures, from y^e^ Extension of body, & space, ~~wee~~ have a No=
tion of /y^e^\ duration of time. ffor the Marks of body's and their
positions and places, falling one after another /that is Not all coincident together\
the Mind
takes the marks in series, being no other, then Notes of
various Extension's compared, and out of them, frames an
Idea In astracto as of an Essence distinct from body Cal=
led, time. And /I doe Not wonder\ that to Comon people It is Impossible, and
to Philosofer's very difficult to consider the Identity
In nature of time and motion, ~~I doe Not wonder~~, be=
caus ~~y^t^~~ /In My owne Case that strove In it,\ when Ever I Remitt my thought, or take of
y^e^
constraint my reason holds of it, ~~but~~ this vulgar thought
of a reall essence of time, distinct from body, Emergeth;
and it is Not a litle labour, to keep it downe. but being
fully surrendered to this Maxime, that My thought's one
way, or other, are No authors to nature for the reall Ex=
istence or Non Existence of things, I goe out from my
Self, and search as well as I can abroad, where I can find
Nothing of time, but Motion it self, and that coincident
and Coevall with the Extension of /Body &\, that. And If I would
deminish Sacred Authority, by subjoyning that to these
profane things, No point of philosofy being so Revealed
as this

16. Relatives

as this; ~~as~~ /vis^{t}\ the Non-existence of time, as to all Meer Spirituall
(that is, In this discours,) Non-corporeally-thincking-beings,
I might boast of a stronger demonstration then any ana=
litick affords.

I shall onely add In confirmation of this, a litle con=
cerning our Judgm^{t} of time; Wherein I thinck appears
the freedome y^{e} mind, in some measure hath, from being
tyed strictly to the account's of motion. ffor Nothing is
more Notorious, then that In our sence, without some In=
dustrious /& artificiall\ application to marks of certein movem^{ts}, time
hath No certein measure: but sometimes by y^{e} Marks, (~~that~~
~~is~~ y^{e} Sun, or clocks;) wee have lost a great deal, and
thinck time very short, and at other times contrarily very
long, and this ordinarily as wee are pleased or displeased.
w^{ch} gave occasion to M^{r} farfax to fancy, and Not un=
happyly, that as more felicity made time short to us,
In perfect happyness, It must ne Nothing: and y^{e} scool=
men's Expression ffor y^{e} NonExistence of time with meer
Spirituall being's is Nunc Stans.[319] And those men were
no shallow thinker's, nor allwais wanting In Expression
tho they gave occasion to great abuses in both. Now If
time were a thing, /that\ had any reall Existence, distinct from
Motion, how come it, that it is so very uncertein, as it
is In our account, /so\ as sometimes to be as nothing, and
at other times, to be thought tedious? I can ans^{r}, that
when y^{e} Mind is at Eas it passeth by all mark's of time
without observance, and when pained observes to
many

[319] *see* notes on f. 12v and 175r.

240r[320]

Vol 7[321] of phantasmes. ~~1~~.

of objects y^t have their forme In y^e Imagination as light [heat?] sound. &c. w^ch are Inconstant, & Not y^e same at all times nor to di= vers persons.

The designe of this head is to Comprehend a Resolution of object's, as have their forme, Not from Nature, but from Imagination, /Such\ as light Sound, heat, Cold, & y^e like, w^ch are names rather of passion in us, then of essences In Nature. ffor there is Nothing Mechanick in them, whatever y^e Caus bears; being Not y^e Same to y^e Same person's at all times, and it is doubdtfull If any two persons In y^e world have Exactly y^e Same Image. wee agree in Names, as Red, blew, Green &c. but No one know's that the red of one, is exact= ly y^e same-like Image as y^e other Calls Red. Some will say it is cold, and other's, very Warm. And that w^ch is Melody to some, is but or= dinary Nois to other's; and how ffew, even of thos bredd to y^e tuning of Musicall In= struments, ever distinguish consonancy's? This is a sort of philosofy, very different from y^e other, and depending so Much on humane Imagination, to distinguish it from y^e Mechanick, (I Give it the title of fantasme. In w^ch wee have two Inquirys,

2. Inquirys. i what is reall in Nature. 2. how that occasions Such Images

what nature hath In reality, from Whence The ffancy Receives such Images, and next how It is possible that such Images Should

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[320] From this page to the end of the present volume (i.e., to f. 346v) RN uses a wide LHS margin.

[321] 'Vol 7' in pencil. On following rectos (beginning on f. 242) a pencilled numbering from the lost 'Vol 7' entity, which numbering has been crossed out along with the original page numbering employed by RN.

2. Fantasmes

Should flow from such Means. And for this
Reason, wee must Resume our Mechan=
ick or reall philosofy. to search In and
about ye World ffor such action's and Con=
sequences, as may probably answer our
Inquiry's. ffor wee that allow of No Meer
nominall philosofy, such as vertues, Qua[=?]
litys, forces, powers, Not deduced Necessa=
rily from Indubitable principles, ~~wch will~~ /but\.
as salves at hand, /to\ serve for Every sore,
must be a litle Nicer then ordinary, to
~~produ~~ procure our Materialls, and Collate
them with the sensitive or digestive
faculty of ye Mind.

That Images come from ye ob= ject to ye organ Exploded.

I prsume there are None left, since ye
ars Cogitandi[322] hath bin published In Most
languages, who beleev that ye Images
of sight, sounds, or odor's, are formed In
and translated from ye object to ye organ
of sence, as the old doctrine was, Even of
ye atomist's, whose process had Most of ye
Mechanick of any other sect; ffor they
most Nonsensically fancyed that cor=
poreall Images, ~~but~~ wondrous thin came
Incessantly from ye object to ye Eye /& caused sight\.[323] of
wch

The atomists nonsensicall o= pinion of sight

so

---

[322] *La Logique, ou l'art de penser*, anon. (Antoine Arnaud and Pierre Nicole), Paris, 1662.

[323] That is, the notion of '*species*', *see* note on f. 210v, above.

Exposed demonstrably.

So many Confutation's Croud for utterance I know not ~~to~~ w^ch^ to ~~S~~preferr. but let it Suffise that If that doctrine stands, body must Not be Impenetrable, for light comes from Every luminary to Every point, and so Every place, is full of Images from Every one of them. And then y^e^ Sciences of perSpec= tive destroy's y^e^ Conceipt. ffor how Comes the Species to Shrink, just as distance Grows? the Image once Quitted from y^e^ body is y^e^ Same sure at all distances; and how Can these Currents or stream's of Images Cross one and other Infinite way's, being Corporeall without Confusion? but time is lost on Such foolery's. Nor are those much better, that Make light a distict Essence that flows from a luminous body, tho they dare Not say it is Corporeall, yet they affirme, and truely, that all the consequences of it are after y^e^ Rules of bodily Movement, but of this more when I come home to the Subject of light & colours, And for other like sensation, w^ch^ fill us with Images, to Assigne an Essence to them Inherent In y^e^ object, is like setting up the species of divers sorts of pain, to Reside actually In y^e^ various Instruments of torture. In W^ch^ nothing

Some assigne y^e^ Caus of Images In y^e^ Sence to cer= tein peculiar essences, flowing from y^e^ object W^ch^ is as bad; & Such are Ray's of light.

4. Fantasmes

If meer Impuls & touch will Not Resolve all our Images of sence actum est de philosofia[324]

Nothing reall is [found?], but dimension & Impuls. The rest is In Imagination. Therefore I must take it for Granted, that If wee cannot connect those, that is Im= puls and Imagination, so as the one, May caus the other, without blending or Confoun= ding their essences, wee ~~have done with~~ /are at a stand as to\ this branch, & y^e^ Most Important of all philosofy.

All this discours will depend on Indistinction or Confusion of objects w^ch^ very Confusion hath its Image.

Here wee Resume that discours I offered before, when I devided object's distinct from Indistinct; ffor Now wee have wholly to doe with the latter, that is Impression's made upon our organ's of sence, from complex Motions, of w^ch^ wee are Not Ca= pable to Make any distinction. but Re= ceiving that Impression Confused, The Ima= gination frames a Representation of that very Confusion, and when y^e^ like againe p^r^sents, the like Image is Conceived. all w^ch^ /sort of Images,\ vanish~~th~~, where the conception is distinct. /And others in distinguishable simplicity appear, most unlike\. So It is with sounds, w^ch^ Come Nee= rest distinction, of any Confused object, & therefore from y^e^ Grossness of y^e^ action is best Examinable by us; ffor while the pulses /of a tone\ are distinguishable, wee have one sort of Idea w^ch^

[324] i.e., 'are actions [perceptible by] philosophy'.

W^ch^ wee call, strokes; but when accelera=
ted, or Iterated so fast wee Cannot distin=
guish them, then begin's the Idea of Nois.
/or\ sound, however Qualifyed, of w^ch^ wee Shall
have Enough to say In fitt place. I Con=
ceiv that touch, when wee say soft, is
no other then a Complex of divers slight
touches Confused; And Even light it self
is but reiterated pulses on y^e^ organ of
sence, ffor w^ch^ y^e^ Eye is Miracolously adapted,
hath an Image unlike any other; and if
that also, I have Much to suggest, when
I come to it.

Nature hath No confusion, Nor omniscience, & our Ideas from confusion are onely In y^e^ Will of y^e^ creator It Should be so, for they are created by defect in us.

It is Not amiss to Examine au fonds[325] the
root of this capacity of ours, w^ch^ will Not
lett us into y^e^ knowledg of objects, with out
Such Gross Confusion; Whence moves all our
Sence of admiration, & Curiosity. ffor If wee
Reflect on our Idea of allmighty know=
ledg, where all thing's are Noted as they
are in Nature, (w^ch^ know's No Confusion,) y^t^ is
Every thing distinct and apart by it self,
but Ideas of sound, light, &c, y^e^ Creatures
of defect, do Not Exist, but In y^e^ almigh=

Such is Harmony w^ch^ is most apt for y^e^ p^r^sent state

ty will, y^t^ it should be so In us. ffor Harmony
of 3^ds^. and fifts In musick, vanish when
y^e^ pulses

[325] i.e., 'to the bottom', 'fundamentally'.

becaus exami=
nable divers
way's, w^ch light
is Not.

the pulses are knowne, that is distinguish[=?]
ed; for then the order becomes uniformity
and Not harmony. and If wee had So Much
more of perfection, as to perceiv all y^e pulses
of Musicall tones distinctly, wee had Never
any Notion of harmony, as one blind can
never have any of Colours. And It is Not
Strang to say that our Images or Ideas
are Not In y^e Almighty, becaus they Re=
Sult from defect; however It may be his
will wee have them, as ~~were~~ Wee are Im=
perfect in knowledg, and so fall within
his omniscience. And this Instance of Sound
is Notorious. and /so\ proper for demonstration
of what wee mean; but All object's of sen[ce?]
WhatEver have the same Conditions, tha[t?]
is to be perceived under an Idea of Some
confusion. It's true, wee have capacity to
Extract some particular's distinctly, such
as an hors, a tree, the sound of a bell, [or?]
of 2. bells, & y^e like, and this leads us In
to our philosofy of Simple motion. but
yet this is but as an Eminence selecte[d?]
or part of a confusion distinguished from [y^e?]
Rest, ffor light it self, & sound are con=
fused Ideas; /what\ then /is\ a thing seen, or heard
~~is~~ but a member of that confusion?

Wee can come
at No distinct
Idea of thing's
y^t since Confounds
but gather it by
reason & experi=
ment.

and

Fantasmes. ~~4~~ 4

And when wee say two lights, two /sounds of\ bells
or y^e^ like, wee mean, two confusions, there
being Nothing truely simple that can
fall under actuall sensation; but as Ma=
thematitian's postulate lines, & figures with
exquisite Exactness, becaus nature admitts
them; so wee demand object's as knowne
In their simplicity, not that wee have any
truely simple Idea, but becaus Such may
be In nature, as wee Suppose, and our sence
Subdeviding y^e^ Confusion seems to Rep^r^sent
to us.

The Extent of capacity In dis=tinguishing Re=ferred to the Com=parative velo=city of ordinary Motion In our members.

One May ask how it Comes to pass, that Wee
Cannot Comprehend any thing distinguish=
able, but within such narrow limits? ~~as~~ /for\
the Numbers 100. 1000, & y^e^ like /are beyond our
comprehension\ who ever
had an Idea of a poligon of 100, sides?
& yet such are deealt withall by the Ma=
thematitian's. why doe two Colours In powe=
der Mixed produce a third; why doe things
passing Swift, seem continued? to begin
with this last, and give a fundamentall
Reason for all y^e^ rest, & other like Instances
of Indistinction; It is to be observed, that
wee have No perception of things but by
mediation of sence, that is of our body's
And those are made of a Such Magnitude

as

as like other Magnitudes, is determined by
y^e proportion it bears to Such body's as it is
or may be Collated with. And Consequently
the Motions of it, and the Member's, are
not Susciptible of such swift movements,
as lesser body's are; ffor whatever is the pri[n=?]
ciple of motion in us, It hath certein Mag[=?]
nitudes to work upon, and Cannot actuate
them to greater then some certein velo=
city. as a man Cannot Swing his arm so
swift, as a fly moves his wing. and admitt
any degree of swiftness, let him hold a
weight In his hand, and that shall slacken
the Motion; and generally speaking, the
action of the arm, is as of a pen du lum
In a certein measure, as crotchet time
In Musick, but y^e finger will take a
swifter Motion, as a Quaver, or less, and
y^e action of Swift performance In Musick
is partly acquired by labour & practise, &
at last, done with, not y^e whole, but a small
joynt of y^e arme, and that of y^e wrist. And
So y^e head, y^e tongue, and other part's have
a certein capacity In Swiftness. the actions
of a child are Swifter then the like done by
men; and of the lesser & lighter swifter
then of y^e bulkye & Gross. but y^e Quickest, of
all o^r part's is ~~that of~~ the Eye, whose agility

The power of swiftness in Mo= ving our Mem= ber's, depends on magnitude and is Regula= ted much upon y^e Reason of pen= dulums.

Fantasmes ~~5~~ ~~9~~

When wee Seek to distinguish any thing it is done, by some Cor= poreall Movem^{t} of our parts, ei= ther actually or mentally.

I Shall have occasion Enough to Note. Now When wee would distinguish one thing from another, It is done Either In action /or the\ Ima= gination of action. 1. action, when sheep that are to be told, pass by; If they come so fast that neither the finger, head nor tongue can Iterate so fast, It is Impossible to Count the Number. So when wee view any thing, wee thinck wee have at once a fair landscape, and accordingly wee Make pictures; but In truth the peices of w^{ch} that is Composed are small, and most thinck, y^{t} y^{e} Eye takes distinctly onely a speck, and the rest is Gathered by a swift transition of y^{e} Eye to & fro. and y^{e} picture being accor= ding to our Imagination, tho Much Excee=

The Eye y^{e} Swif= test of o^{r} Members, w^{ch} makes specks vinite In breadth

ding a distinct view at any one time It is well Enough. And this swiftness of y^{e} Eye, is what wee cannot take an account of by any other mean's, w^{ch} makes the cours of it here & there unite In our Imagina= tion as a Continued thing; for No part of us will move so sudden as y^{e} Eye. Hence wee have a competent apprehension of a

[w^{n}?] things are past this transient distinction, then confusion begins.

few things at one time, as 2. 3. 4. 5. & scarce ffarther; when wee Come to 10; 100 & y^{e} Idea is [~~meer~~?] Confusion; & turnes to meer

hypothesis

or Nominall knowledg; as when under
a name, the thing is supposed, but Not by
any Image of y^e^ mind Conceived. and as
wee use Names In such cases, so shapes also.
as at games with cards; If the 10^s^. 8^s^, or 9^s^
were not pipped in a Constant Regular
manner, but Incertein & various, a games[=?]
ter would loos his attention, from y^e^ Game
to telling his pippes. but y^e^ passing to &
fro upon y^e^ Card, takes y^e^ Comon figure, &
then all In one Instant concludes y^e^ Number.

Action bounds
y^e^ Capacity of y^e^
Imagination, w^ch^.
is but Memory
of practis

2. The Imagination will Not Exceed action
as to any Capacity; ffor it is but y^e^ Memo[=?]
ry of action, and accordingly applying it
when y^e^ Sheep pass by, a man, without help
of any actuall movement, may Count /[as?] such [....?]\ but
he hath in his mind a movement ~~such~~ as
he hath made /[....?]\ & may againe use If he Will
So Musitian's who measure their time by
y^e^ pendulous swings of their arm, w^ch^ are
those they Call Crotchetts, but having long
notes to deal with, as they call, larg, lon[g?]
Breif. &c. they have a mentall subdevi[=?]
sion Into Crotchetts, by mean's of Imagi=
nation, and so determine of larger mea=
sures according to tale. And In short, the
Imagination is limited as it is taken from
practis, and is but the Remembrance of it.
therefore

Fantasmes ~~6~~ ~~11~~

Things are Com=
pared by Such
transition In Me=
mory from one to
y^e^ other, When
one is attended
too, y^e^ other is
In y^e^ Memory, or
both.

therefore it is No wonder, wee have not a capacity of larger Comprehension, and so ffew Individualls can be taken Into our minds at one observation. ffor wee have our knowledg from y^e^ Conveyance of so much body, as will Not actuate it self In compyance with y^e^ litle Itemes that compose those w^ch^ strike our sences. And this I Shall conclude with a word Concer= ning attentive Comparison of thing's, w^ch^ is done by alternate transitions from one to another, Either by actuall sensation or Memory of it. as when we Examine, whither Magnitudes, Colours, tasts, &c are alike or Not; In doing w^ch^, the things Come together alwais by help of memory of one at least, & Not otherwise. It seem's the at=

Attention Can
be but to one
thing at once.

tention will Not be devided, ffor y^e^ Mind is but one; but when one object is p^r^sent In sence, y^e^ other In memory; /and\ being y^e^ last thing attended too, is therefore strong, and so by sufficient Number of such transitions wee Make a Judgm'^t^. And When Many thing's are thus proposed to Judgm'^t^, the Me= mory of one is confounded, by that of others, and No Comparison is well made but In the simplicity of two thing's onely. And If this ac= tion of y^e^ Mind be, (as may be,) done onely in y^e^ Memory, It is all alike, for reason's G<u>iven</u>.[326]

[326] As the underlining of the final word suggests, RN is moving to a conclusion here, he crowds this last line into the bottom of the page.

12. Fantasmes.

The Idea of Con=
tinuance, Is in truth
made up of divers
sensation's or Items,
Indistinguishable
for tho Continu=
ance is In Nature
it is Not in Sence.

swift pulses Seem
continued, becaus
the memory of y^e
one overrreaches
y^e other, & so uni=
tes, or mixeth them.

As to the Continuance of Motion, & time
the Consequence, wee must allow y^e Nature
of it to be without any Interruption. But
If wee Reflect on our Idea's occasioned by
~~from~~ it, wee shall find reason to thinck there
is No such thing as Continuance In our
Minds; but our whole sensation is Compound
of distinct Item's or pulses. And against this
It is No argument to say, wee perceiv y^t
time is an uninterrupted Cours, ffor our
perception's are Not of thing's as they are,
but occasioned by them, and are rooted In
fancy or Imagination, & there wee must
look ffor the plastick seat of them; as Most
plainely is demonstrated by Musicall tones
& harmony, w^{ch} to our perception ~~are~~/is\ Conti=
nued, tho knowne to be distinguished Into
pulses. And here another reason offers itSelf,
why frequent pulses give an Idea of Con=
tinuance. very soon after one, y^e Memory is
strong, almost Equall to y^e force of y^e Next
puls. and after a puls, memory is some Con=
tinuance, tho y^e thing is Instantaneous. so
reiterated pulses, not letting y^e Memory
wast at all, blend together & Seem Conti=
nued. Now Judging that y^e mind as being
one Cannot attend to divers things at once,
and our apprehension of variety, that is of
motion, is but attention to y^e changes it

makes

makes, our attention leaps, and hath periods
dwelling here and there to observe, tho the
Motion moves Equably, & w^th^out Interruption.
ffor w^ch^ reason, I am of opinion, that all
continuing sensation's, are but frequent pulses
that is distinct attention's to various objects
In periods, & Not continually flowing. the
Geometers may suppose fluxion's In Motion
becaus the Nature of Motion is so; but there
Is No fluxion In Humane Sence, but stopp
of attention, and time it self composed of
distinct Item's of thought, or, w^ch^ is y^e^ Same thing,
pulses.

Intervalls be=
tween one puls
of sence, or between
one attention &
another are lost
in acc^o^ of time
as sleep, &c

If an almight power, should Interpose
any Intervalls, between one sensation and
another, that intervall is Not perceived
and, as to time, lost, as Of None were, and the
time renew's at the next attention; w^ch^ suc=
cession of attention's is, to our sence, time,
And without Miracle, but ordinarily, there
are More or ffewer degrees of true time pass
between one attention and another; as If
y^e^ oscillation's of pendulum's were to speak,
they would tell us time flow's Equably, but
Say wee, It is Impossible, ffor your hour
Cannot be half an hour, so soon is it
Gone. that is when y^e^ attention passeth Swift
from one Item to another, that Swiftness
is

14. Fantasmes

The reason of the Inequability of time, from y^e^ swift or slow transition of y^e^ attention.

is the swiftness of time. ffor when the at=
tention ffinds no aggreableness in chang,
It moves slow, & that is y^e^ dullness of time.
And whatever Intervalls are between one
attention, & another, as to us they are lost
time. and this is y^e^ true reason why wee
thinck time unequall, w^ch^ by Regular
movement's is accounted to pass, whither
wee attend, or Not, equably. How ffar our
Sleep & dream's are Concerned In this Notion
I Referr to y^e^ Essay of them,[327] and forbear it her[e?]
and Conclude, that all y^e^ while wee see, hea[r?]
Smell, feel pleasure, or paine, wee are held
In attention by Indistinguishable changes, o[r?]
pulses of object's upon y^e^ Sence.

The understan= ding depends on distinction of things, and so is Not at all Re= quisite to render sensation's agrea= ble or Not; ffor mixtures may pleas or displeas & we know Not why; nay when there is distinction Enough, wee doe not see y^e^ Caus.

The next thing Considerable and Indeed
wonderfull, is that knowledg /of y^e^ Ingredients\ is Not at
all
Required to the gratefull or Ingratefull Effect
of these objects of sence. ffor Sounds propor=
tionately Mixed pleas, and oppositions and
Irregularity's are strangely offensive, tho wee
are wholly Ignorant of y^e^ Ingredients. So it is
when Many persons shall agree that a dis=
position, /such\ as may be accurately distinguish't,
is beauty-full or aggreable, and No one Can
say, why? Motions that pleas, or offend, hav[e?]
no dependance on humane science, but this
subject is more nicely traced In y^e^ dicours
of pleasure & paine.[328]

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[327] *See*, for example, 'Some farther deliberation's Concerning sence & attention, In order to Investigate y^e^ Nature of Sleep & dreams', BL Add MS 32526, f. 12v ff..

[328] *See*, for example, 'of pleasure and pain', BL Add MS 32526, f. 19v ff.

wee know No= thing of caus, so as to Resolve y^e^ Effect's of Ima= gination; but can discover many things without us w^ch^ are y^e^ occasion of our various Imaginations.

Another thing, and Most wonderfull of all is. that wee know less y^e^ causes of appearan= ces, w^ch^ are formed within o^r^ Selves. then y^e^ nature of thing's w^ch^ are the moving occa= Sion of them. or rather wee know Nothing at all within us, and all wee can gather is the Nature of Externall thing's, wherein wee are ledd by the diversity of Images within us. as, to hold o^r^ Instance, wee have discovered that the sound of a fifth, w^ch^ rings so Well In our Ears, is /In Nature but\ pulses in y^e^ proportion 3/2.

But wee Cannot know any caus why that proportion gives that species of harmony. And We may p^r^tend to know that light is the effect of pulses upon y^e^ tender humid Eye, in some certein manner, and as that is diversifyed, wee distinguish Red, azure &c. but What is y^e^ Reason that Such pul= ses y^e^ exhibite Red, should Not exhibite azure, or any other colour, wee can Never from y^e^ p^r^sent state of Naturall discovery find out. D. Cartes, Refferrs it to y^e^ Will of Heaven, and rightly; as it is also, that a a bowl should run, & every Naturall Con= sequence happen; but yet wee are allowed to observe how principles have effect, and It were as resaonable for us, If wee could to know how it happen's, if wee Should

from

from certein touches, conceiv Such pecu=
liar and distinguishing Ideas, as sound
light colours. &c. w^ch^ of y^e^ latter sort are so
surprizing & wonderfull, and so In great
measure, tho Not So Eminently, In sounds.

A sensitive crea=
ture is composed
of Infinite parts
& members, all
w^ch^ are capable
of variety.

To walk as farr as wee Can, in this dark
laberinth: let us Consider, that one thing
may be satisfactory, w^ch^ is, that the compo=
sition of the sensible machine, is of parts
Innumerable, If Not Infinite, and the Com=
bination's of chang, as may happen amongst
them sufficiently so, whereby y^e^ variety's
of life from y^e^ Infancy of y^e^ longest lived
animall, are so few, they bear No propor[=?]
tion to what changes Nature admitts, In
Such Numerous Ingredients. And over all
these, y^e^ mind is sur-Intendant; and In
generall, hath No object, but the chang
of position, or place, among the part's of
the Infinitely complex systeme, to w^ch^ it is
annexed. If it were possible, that the whol[e?]

The variety not
under one sort
as might be, that
is called touch.
yet even that
may be Infinitely
varyed.

Mass, were but one Sort of substance, w^th^=
out organ's, or disposition of sence In one
part more then another. then there Would
be No other perception but, such as wee
call touch; And Even that Must admitt
of variety, ffor the Matter having

difference

difference, and chang of position, ~~is Not~~
~~y^e^ Same~~ when it happen's from various
matter here or there placed In the sys=
teme is also various; even /comon\ touch hath In=
finite variety, w^ch^ ~~serves~~ aided by atten=
tion & tryall, serves to distinguish on
what part the touch falls. as the touch
on y^e^ foot, is Not y^e^ Same Chang, as when
on y^e^ head; so Experience first, & then
Instinct (not here to be Explained) In=
structs animalls, to know their parts,
when affected by touch, & to distinguish
one from y^e^ other, and at length use
Gaines greater Nicety, as wee know by y^e^
use of our ordinary Manuall feeling,
by w^ch^, as Some say, blind Men have dis=
tinguished colours.

That sensations become grossly different, and distinguisht In= to organick per= ception.

But If it happen's that any part of this
lump should be sore, that takes a New
capacity, and is like an organ of Sensa=
tion, ffor Nothing can touch there, but
with an Impression ffarr different from
all the rest, and Gives us an Idea wee
Call soreness. And If Instead of that, there
were a bruis, another Idea attended ~~i~~yt,
w^ch^ wee call Aking. and so upon other

affections

18. Fanstasmes

Affection's of y^e^ parts, Extraordinary or accidentall, the Idea's correspond In newness or variety. Now it is No More rea[=?]sonable to ask, why a bruis makes aking and the skin-off, soreness. then why a ~~triandle~~ triangle, or a Quadrangle is Such. It is a variety of Mode, w^ch^ the essence ad=mitt's. and when wee Grant y^e^ one y^e^ other ffollows; therefore as chang is In y^e^ Essence of body, so variety is In y^e^ Essence of thi=cking or perceiving. And when wee admitt perception occasioned by body, wee must admitt, that different modes create diffe[=?]rent Ideas, and that they are different is all wee can affirme of them. as wee can=not affirme of body any thing of difference but in its modes, or variety's In y^e^ Manner of its position or Extension. but Wee May Give names to any thing, and so help y^e^ Memory to know when y^e^ Same or like Re[=?]turnes; as wee have y^e^ Names of triangle & Quadrilater, so the sensation of them May be termed triangular or Quadrilaterall. And thus wee acquire a knowledg of Species In sence. ffor having downe In our Memory the Impression's certein object's Make, wee catalogue & know them againe.

variety In thin=cking follows y^e^ modes & varietys of body. and per=ception by y^e^ Means of body, admitted, the changes follow.

Ideas are various from various con= stitution's In y^e^ object or occasi= on of them. tho wee cannot come to know the con= dition of such con= stitutions simply taken.

It is Not Materiall to perception, that y^e^ object's are distinguish't, ffor one may be composed of triangular Ideas, and y^e^ other of Quadrangularity's, and wee Not know it for reason' Given, and yet the Idea that comes from an object of y^e^ one sort Indis= tinguishable, differs from one of the other. And So May be alternately knowne, by y^e^ Idea, as often as Either Returnes. And for want of distinguishing wee Can onely Mark or Name them; but it is a vaine thing to Inquire, why the one hath such an Idea, that is, why blew, is blew; Harmony of 8^ths^ fifths, or thirds, is such. and why other Impressions have also their peculiar Ide= as. It is Enough that confusion In y^e^ object hath an Idea w^ch^ wee cannot anatomise by Meer sence, onely know that, ~~it is~~ (like body's in systeme,) It is as it is, and Not as other confused objects striking y^e^ Sence; So that all is Resolved Into difference be=

As y^e^ capacity changeth y^e^ object w^ch^ is allwais y^e^ same seems to chang. as when from confused to\less confused, or distinct.

yond which our ~~knowledg~~ /perception\ in confused Cases will Not Extend. And If y^e^ faculty's were nicer, and distinguished the order of y^e^ object, It took another forme, that is dis= tinct: and the Idea of y^e^ Confusion vanisheth such vertue hath want of Capacity In humane

perception w^th^out any confusion would deprive y^e^ world of all its beauty's.

humane perception, w^ch^ Made More per= fect, would deprives of the wonderfull I= mage wee have of the world and Its a= mazing object's of various kinds, Redu= cing them to y^e^ Simplicity of Matter and Its modes; w^ch^ is void of such Elegancy's as Confusion affords In our Imaginative capacity.

These varietys organized Into Gross distinguish= ments, have an admirable use.

This vertue is Sublimed in us, by the Miraculous disposition of organ's of sence. ffor setting aside Comon touch, and one branch of it a litle more Eminent, Called tast. there is In y^e^ head place'd a Membrane called y^e^ timpanum of y^e^ Ear. w^ch^ hath a Spring, and Receiv's the tremolous Imprest

Hearing Informes by mean's of the spring of y^e^ air not otherwise to be perceived.

movements that fall from the Spring of y^e^ air; and by that mean's creates an Idea so Much nicer, then any other Exterior part of y^e^ body, (for No part but this Membrane, feels the tremula's of y^e^ air) that It is dignifyed by y^e^ title of a distinct sence Called hearing; and well deserves it, becaus It Informes y^e^ animall of every thing that moves the air In that Manner, and In due measure. and ~~with~~ /by means of\ Subdevided va= riety's, helps to distinguish one thing from another, as is well Enough knowne to us

In

Fantasmes. ~~11~~ ~~21~~.

Sight Informes by mean's of a subtiler Mat= ter then air wch permeates ye membranes & humours of ye Eye. and In ye touch made upon ye bottom keep's the order of part's /or places\ In Won= derfull manner.

In like manner, but by a much more wonderfull organ, wee have Impressions by touch, from a matter that penetrates where air will Not come, that is ye Eye, thro wch and all ye liquor's of it, this matter convey's force to the Retina at the bottom of ye Eye; and that by Institution (for It is Not chance) is of tenderness to be so Impres't and is Conserved in it. by the liquor all= wais upon it. And the formes of this organ I mean the parts, and disposition of them, are so accomodated, as artificiall Glases, to deposite upon ye Retina, Each point that sends a touching Influence, In due place & proportion, that ye Influence is not onely felt, but with great distinction and order of the objects /(Grosly) whereby\, their very shapes ~~is~~are also felt.
Wch is so Consummate Evidence of designe, yt none without Stupidity will doubdt it. thus Much I have sayd In generall of the diffe= rence between objects of ~~the~~ sence, and the ~~p~~ffantasmes of them In our Imagination, under wch they are perceived; As a pr para= tion, to an undertaking, & No slight one, of shewing ye Mechanisme of light & Colours. And becaus the conveyance of Sounds & light are thro ye Same medium, I must coincidently

coincidently discours of them also.

The late philo=
sofy of light, &
particularly
[...?] of S^r Is. N.

That it is an E=
manation really
flowing from y^e
object.

Quasi corporeal.

Ray's of appro=
priate Colours,
appearing when
sorted forth Each
apart, as is done
by different Re=
fraction, or the
Refrangibility
of them to diffe=
rent Angles,

Wee have touched already, that the Caus
of seeing, cannot be corporeall species
flowing from y^e object; and somewhat touchi[ng?]
M^r Newton's Notion's,[329] but of them a litle Mo[re?]
particularly. He supposeth that light is
Somewhat /called Rays\ that flow's by ~~y^e~~ strait lines from
the luminous, or luminated body, with In=
credible swiftness, and Notes y^e time It is pas[=?]
sing, from y^e satellit's of Jupiter, to us, w^ch is
ffarr Enough to Come, as they account, In
..... of time. he doth almost, or tantum
non[330] affirme Ray's to be corporeal; becaus
It is Manifest, all y^e Rules of the passage
& Reflection of light, are the same as are
found to Governe the Impulsive Motion; that
Regarding partly Impulses of simple
body's, and partly the complex motion of
fluids, you have the Indication of all y^e Steps
light can or ~~dooth~~ doth make. then these
Ray's, or parcells of them w^ch the opticitian[s?]
call pensills, are composed of Individualls
that have a distinct nature, as to Causing
In us the Idea's of diver's Colours. So that
as wee perceiv Colour's, it is but Ray's y^t
caus that colour, w^ch wee perceiv; and If
other Ray's are substituted of another Sort
other colours, appear. That these Ray's of
all Sorts ~~blended~~

[329] Newton received his knighthood in 1705 - which may not have been in time for the main body of the text, but was evidently in time for this marginalium.

[330] i.e., 'not only'

of all sorts, that is all Colours blended to=
gether gives us the Idea of generall light
or white; That each colour hath a proper=
ty to Refract thro angular mediums /(as for Instance
prismes)\ to
a certein angle, therefore In such cases y^e^
collours y^t^ can pose y^e^ light, are devided by
Refraction, & layd In rows, as Comon obser=
vation, Especially of y^e^ prisme shews. but
who would have an Exact account of this
Systeme, must goe to y^e^ author ffor it, becaus
these here are but touches, to Make what I
have to say be understood.

The action of light affecting us, as body, Must mean y^t^ it is done by body.

First to say that light act's after y^e^ Rules
of body, amount's to an affirmation that
it is body. ffor there is No Medium between
penetrable & Impenetrable. then to Say
as he doth that, body will turne to light,
and light to body againe, Is to y^e^ Same
Effect or Nothing. ffor If body Reteins Its Im-
penetrability, as I thinck will Not be denyed
It is all one what it is called, ffor the thing
is still y^e^ Same; and for a being to chang
from penetrable to Impenetrable, and
E conversò[331] againe; doth rais rather our
wonder at the discours, then any Image
of an Essence possible to Consist with y^e^
knowne Nature of body. ~~there~~ And If one
would prove that light act's meerly by
corporeall mean's, wee need say No

more

[331] i.e., 'and convert'.

more then, that wee perceiv it; for our
organ is body, and the moving that Makes
us perceiv; and body (ordinarily) is Moved
onely by Contact of body. And there is all ye
signes yt can be of bodyly force upon ye Eye
by light. ffor If made disproportionately
strong It shall dislocate ye part's & destroy
the organ it self; as some by great lights
have bin blinded. therefore wee Shall Make
No bones to Conclude that ye sence of light
is caused, as other sensation's are, by bodi=
ly Impression upon ye organ; that is by meer
touch; and the Image of light caused by it, is
the consequence of a peculiar tenderness of
ye organ, wch No other touch will, In that
manner, create, but such as luminous body's
caus; how this touch is diversifyed so as to
Represent shapes and colours, is a profound
mistery, of wch more In other place; and
her /I\ conclude with ~~one~~ /a\ comon observation /or two\
wch prove touch to caus /in us\ the Image of light.
And that is when clownes rudely with fists
strike one & other's Eyes, they tell that fire
flew out of them, so that an Externall
Stroke with such violence, as shall Com=
press the Retina, gives sence ye Image of
light; and a touch of ye finger at ye Corner
of ye Eye, neer ye place of ye Retina makes also
an Image manifestly Inlightened. Then

Any Corporeall obtrusion Grossly on ye Eye gives us a sence of light, If some all, & none other.

note, The light made by gross touch, is like that of finer, Inclined to Colours, therefore the No= tion of Ray's, &c a figment.

Light passing is a demonstr= tion y^t^ the World is ffull,ag^t^ S^r^ Is. N. 1 Op. y^t^ y^e^ Inter= planetary spaces are void.

Then taking it for Granted, that bodyly movement derived from y^e^ luminary to y^e^ organ is y^e^ Caus of light; wee conclude first, that there cannot be In light any thing Inconsistent with y^e^ Nature, & essence of body In the world; one consequence of this, and, admitting y^e^ p^r^misses, demonstra= tive, is that the world is full. and No vacuity in it, at least Not as S^r^. Is. N. sup= poseth, all y^e^ vast planetary spaces to be void of body. ffor /y^e^\ Influence must be Either by means' sof continuall Emanation, or perpetuall contiguity. If the former, light with its Emanations must fill all places, ffor No point is free from Its Influence at ordinary distance, or where light is. If the other, then light finds y^e^ space full, & /so\ useth it. and Either way, there is No va= cuum; and surely Nothing can be so

Vacuity Exqui= Sitely opac.

Exquisitely opac as meer vacuity. there is No Evasion of this but saying light is another essence that penetrates bo= dy, and it self also, to w^ch^ one that Can assent, may have solution's allwais ready to serve any turne. And there is demonstra= tion ag^t^ that also; ffor If light penetrates

body

26. Fantasmes

If light penetrates body, all body's must be pellucid.

body, then all body's Must be pellucid, and No opacity In the world. If It be Not so, but light creeps thro the Interstices of some compounds, & Not of others; It is becaus light cannot penetrate body, and then, it is body it Self.

That light turned Into body & E Contr a Strang sentence.

As for the wonderfull saying, that light turnes Into bod[y?] and, body Into light. becaus some Matte[r?] by being Combustible, may become luminous, is the same as to say, a body May turne Into Sound, becaus it causeth in us the Image, or sensation, wee call sound. Geometry hath small share In such reasonings.

Light can be No real emanation of any thing from ye luminary & passing thro ye medium to ye Eye

That light is No Emanation, is to be so demonstrated, as I thinck without Renouncing all /reasonable\ principles, wee cannot owne it. ffor how can a Single luminous point fill an whole sphear with light, and this In an Instant, and Not onely filled, but gone, and filled againe, as one yt stands by shall pleas to Interpose, or remove a Screen? /and ye is yet More strang, maintain a Continuall Current?\ they Say Indeed, light passeth with Incredible swift[=?]ness, wch is so farr true, that /both the measure &\ ye passing of it in that manner, is Incredible. and not onely one point, such as a candle is to ye Extent of its light, but many nay Innumerable

Fantasmes. ~~14~~ ~~27~~

Innumerable such act y^e^ same, as In a
theater, /where\ with all y^e^ Reflections, lights con=
tinually, tho Quietly & safly cross~~ing~~ Each
others (supposed) Emanation's. Most Grant
the Medium of Comon air to be neer ~~full~~
If not altogether full of body, and It seems
neither that to light, Nor light to itself
is any disturbance, or caus of disorder, tho
Each Cross y^e^ other Miriads of ways. one
Might ~~alsl~~ ask also, when this world is Once
full of light, what becomes of it, at ~~mig~~
midnight? they say it is a Stream or Current
from y^e^ luminary Called Ray's; w^ch^ Intercep=
ted, It doth Not strike our Eye. but then it
is allway's powring in still, and tho stag=
nating, is light; perhaps It goes Into other
luminary's, to supply y^e^ Stock, & be Shott out
againe; or It coagulates Into, or Setles upon
combustible matter, and as they say turnes
Into body, and light againe alternately.
I cannot allow the Epicurean Continuall
current of Species, to be more Extravagant
then this Inundation of ray's, a Stream of
light, actually flowing from y^e^ luminary.
And at the same time carry all y^e^ Symptomes
of body, there being No circumstance of
complex motion, w^ch^ is Not found to have
place In y^e^ action of light, as Even they admitt.
now

That light is
[i?]s a current of
ray's more strang
to hold then y^e^
Epicurean Species

28. Fantasmes.

Light Must have a solution Me= chanically or Not at all.

Now having so much allowed me, that light In Every thing acts In ye Modes, & hath the Consequences of body, that is touching Re= fracting, & Reflecting; I must Conclude that whatever ye principle is the action is Con= veyed by ye mean's or medium of body, & hath Mechanicall solution, as other Com= plex motion's have, or, If rightly understood May have.

light act's by protrusion of the medium; this foun= ded on ye notion yt all motion or Im= puls, hath Influence ad Infinitum

It will follow then that light cannot pass in a trajectory way, that is by Cor= poreall Emanation's really Issuing from ye luminary, and flowing all space, even to Infinite (as, may be sayd) round about. All wch is Inconsistent with ye clearest of truths the Impenetrability of body, & perseverance In place. But It Must act some other way, and, If by ye Mean's of body, (& what way els?) by protrusion of the medium; wch being stated In perpetuall contiguity, a consequence of plenitude in ye world, whatever Motion is Excited In it hath Influence ad Infinitum. And It being ye Nature of fire, as I have to Shew, to drive from it the adjacent Me= dium; that force passeth according to ye laws of Motion to ye Eye, & there is (artfully) conveyed in likeness or proportion to ye bottom of ye Eye, & is ye touch wee Call light.

so

The same de= monstrated by Induction.

so y^e^ Induction falls thus. light act's as body, w^ch^ is y^e^ Same as to affirme, as wee doe, that it is the Consequence or Effect of body. And that Can be but two ways, 1. by trajection, 2. by protrusion. the first Is Impossible, there= fore it Must be y^e^ latter. Now Some May affirme y^e^ like, of the latter; or that it is an opinion so Monstrous & Improbable, that deserves to be put in y^e^ Same Class with y^e^ Impossibles. Now it is Incumbent to Shew the contrary of these. And first that the Modes of body agitated, Exactly conforme with y^e^ Modes or Nature of light. And since things of this nature, Cannot be discours't, (however thought) but under the forme of sensible Images, I must be Content to Refferr to ordinary occurrances of motions simple And complex; ffor Rep^r^senting my thoughts And thereby, when it is Impossible to demonstrate what is, demonstrate What may be, w^ch^ In science, hath y^e^ Next place to it.

The opinion Not so Monstros but may be made easy by familiar Examples of [Million?] notorious.

I come then to Shew, that these two Grand phenomena of light; 1. acting with In= finite Crossing/s\, and /yet\ distinctness conserved. 2. Every luminary, & Reflection (seming= ly) ffilling Every place. /are solvable by y^e^ ordinary rules of motion\ as to other Incidents

as

30. Fantasmes

as Colours. &. Somewhat may be Sayd /also\[332] tho
that is ye harder chapter of ye two.

All manner of protrusions of ye medium every way consistant with each other.

1. As to the cross process of light; Wee Con=
Sider ye Capacity of body Simply; and Re=
member that a body was capable of Infinite
various directions, at the same time, And Each
one without concerne with or disturbance of
the other. As a boul running on a plane;
is Not disturbed, by ye diurnall Motion of ye
<diagram> Earth, and the like if [~~.~~?] ye Motion were Infi=
nitely Complicated If a Body were Made to
Move from A. to. C. and an animall sat
at D. then a stroke fall's on B. the ani=
mall is sensible of it as If No Motion were
from. A. So If ye animall were at A. and
the Stroke opposite to ye Cours at. C. the ani=
mall would perceiv it. as also any stroke
or number of strokes (admitting Capacity
of sence) to Infinite as may fall on this bo=
dy Moving or Resting. and the Influence of
<diagram> one stroke, doth Not destroy, or disturb the
sence of ye other. Then to enter Complexity,
let ye Space A. be an agregate of body's
continguous, In ye Nature of a fluid Me=
dium. let a Stroke on the Surface at B.
dispers an Influence In the angle H.B.G.
and at C. In ye Angle F.C.D. and at E.
In ye ang. B.E.D. These severall Influences
cross

[332] This page offers a good example of the problem of reading for a chronology of writing. The main text (with its wide margin) is written in a pale/faded ink, the marginal comments and diagrams (plus this single correction) are in a darker ink; the marginalium is in a different ink from the diagrams. The darker ink has been added later (as seems to be the case throughout this essay). But the main text bows around the lower diagram, having been written around an earlier pencil version (still visible under the ink).

cross Each other In y^e^ Space A where an a=
nimall of Nice sence Residing should per=
ceive all these Influences distinctly. All w^ch^
is No More then, and Reducible to the case of
a single body, w^ch^ shall carry y^e^ Influence
of Infinite strokes, that is have Infinite Motive
directions at the Same time, without any
confusion att all. ffor In truth there is Nothing
reall In Motion, but Respective chang of dis=
tance & position of Matter, that hath No limitt.

This Rep^r^sented to Sence by y^e^ un=dulations on y^e^ Surface of water.

This is Rep^r^sented to the thought, but wee
must ayde y^e^ thought, by some Imagination.
that is Exposing to it some sensible actions
of body, as May Explaine our Notion; w^ch^ May
be done, tho the things are Not Exactly, y^e^
same. And for this take y^e^ undulating u=
pon the Surface of water; ffor If you rais
them In 40. places of the same pool, they
Shall spread, crossing Each other, and Every
one Reteining its circling distinct, and one
may see them, after passing, open againe,
& proceed distinct. and as 40, so any Number
of Circles without stint; and more then so
Each shall make a Reflection at the Sides
and Returne In a cours accordingly. In=
creasing y^e^ Crossings. And all this while a
spectator Shall discerne at first the distin=
=ction

32. Fantasmes

The Ripple of water tho see= ming confused is Regular.

=ction, but when it Comes to be Much Redou[=?] bled, with various courses and Reflection's Intersecting Each other, he Shall be lost as to farther knowledg of these Movem^{ts} and below the whole surface to be actua[=?] ted confusedly, /as\ In an accidentall Rippling ffor what he doth Not distinguish he Calls confused, whereas y^{e} Confusion is Not In thing's but In his Consideration of them. ffor No part of that Ripple, but is part of a cours or of a Reflection, originally de= rived from one of those strokes, and conserved as all y^{e} Rest are to Infinite deminishing.

Supposition y^{t} by y^{e} undulation's an animall May perceive y^{e} bea= ring of its center or point of be= ginning.

Now I will Suppose, w^{ch} is Not Naturally Im[=?] possible, that an animall is Capable [to?] note the place or dBearing of y^{e} Center /of each undulation \ from it/self\, by No other mean's then the manner of this circling from it. as If the Center be to y^{e} North, when y^{e} circle comes to the a= nimall, It shall point, & say It began the[re?] And so for the Reflection's. wee at the Sam[e?] time Suppose an animall, capable to dis= tinguish More then one, or divers /yet\ more as y^{e} Capacity may be, and Say, now I perceiv 2. 3. or More centers, at or Near the Same time, or so many as May Not be distinguishable. ffor If y^{e} movemts proceed distinctly

distinctly, the sense of them may be dis=
tinct, as an animall is armed with facul=
tys for it. I doe Not say that this Resem=
bles the Case of light ffor It is plaine, It
doth Not, becaus ye action of light (seems)
to be In an Instant, and this motion is Suc=
cessive. And therefore apperteins more to
Sound, then to ought Els, as may be Shewed
In fitt place. But it is sufficient ffor occu=
lar demonstration, In a way Experimentall,
that Motion's of ~~d~~Body admitts Infinite de=
cussation's, Each prserving the Cours and Ef=
fect, without being disturbed by the other.
And for this reason it is that, the shining
of a light from ye South, is No hindrance
of our Seing one from ye East, or West, tho
Each of these, and of Every other discerna=
ble at the same time, fill, to our thincking
ye Whole Sphear. Wch, I am bold to say, Is
Impossible, by any other mean's then I have
Shewed.

This Instance Not ye Same as light but rather as Sound, but compe= tent to demonstrate to Sence, ye decus= sation's of Motive Influences wthout confusion.

But since this Image of a watery surface
Is Not Exactly Quadrate with the action of
light; And also considering that light and
Sound pass by ye Same medium, as wee Con=
ceiv, It will be necessary both to Shew how
this Instantaneous action of light May be,
and also how Consistent with sound,

That light is consistent with Sound tho Passing by ye Same Medium.

wch

34. Fantasmes

y^e latter Shall but touch, being Reserved
to a proper discours of sounds.

A conceipt of
a body of Water
Impelled, Shewing
y^e action both of
Sound & of light
from y^e Same force.
and carryed on
In a Continuall
paralell of light
& sound.

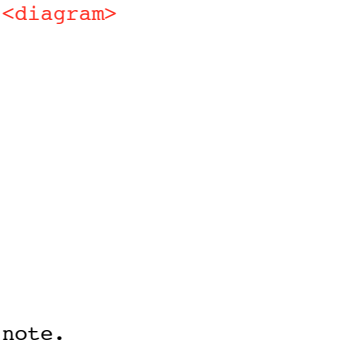
I propose one Image to the fancy, capable
by Mentall augmentation to give an Insi=
nuation of an Intire Idea of light & sound
And that is a larg Cisterne of Water of a
Cubick Content, ffrom w^ch conceipt wee need
Not abstract Gravity, but take it as it ~~t~~Com=
monly is seen. This so, one Comes & with a
ferula strikes the Surface of the water. here
are two Consequences, the first is an undu=
latory process of y^e surface, w^ch Rep^r^sents
Sound; and the other is a force Imprest on
all y^e sides of y^e cisterne w^ch the water touch=
Eth, and Rep^r^sents y^e action that Causeth
light. the former is Graduall, and how it is
acted In y^e air, accordingly, is deferred. but y^e
other, by Mean's of the perp/et\uall Contiguity
of y^e water, is Instantaneous, and spreads
Every way In an hemisphear, without In=
creas, deminution, or trajection of Matter,
from w^ch, (being Supposed,) Springs all the def=
ficultys & Mistery In y^e Caus of light. and
those Removed, I may con licentia[333] of the
[Jingle?], say, the light will clear ~~up~~ /it Self.\

These consequen=
ces of force In
fluids, made
good by Expm^t.

That there is such a sudden & generall
force disperst thro y^e fluid In this manner
May be Experimented, If wee will borrow
some

[333] i.e., 'with permission'.

Fantasmes ~~18~~ ~~35~~.



Some aid of Extreames. ~~A Slet~~ let a small capillary foramen be towards the bottom of the vessel, thro w^{ch} the water shall Issue in a trajectory or parabolick line, as at A.B. & Mark y^{e} point. B. then strike the water at c. and y^{e} forme of y^{e} parabola [will?] alter to A.E. and so at every stroke the Influence may be observed. This I Instance in a Moderate ves= sell, but it is y^{e} same in pond, lake, sea, and truely Speaking, y^{e} Influence of an Im= puls, In fluido ~~Never ceaseth~~ /is not terminated\; altho our

note.
It is possible fishes may feel strokes on water, & so have a sence, y^{t} is Neither Sight Nor sound.

Capacity of perceiving it is soon at an End. Now I will suppose Insect's Creeping on y^{e} Sides of the Cisterne, under water, or fish Swiming In it. I thinck None will deny but at y^{e} Instant (or Imperceptibly /if\ otherwise,) these animalls May perceiv the Stroke, as If layd on /upon\ their backs. If The water be struck in divers places, each gives a distinct Influence, altho Each cross y^{e} other In all the medium over, without disorder or Confusion, as by divers such capillary vent's May be tryed, when at Every stroke In Every place, ~~st~~ the stream shall start out, and so much y^{e} More at y^{e} Same Instant, If all y^{e} strkes are together.

The Influence of strokes passeth strait & Not Curb from y^{e} uniformity of y^{e} fluid.

That the Influence of these strokes pas= seth In strait & Not In Curb-lines, will Not be denyed, ffor the whole fluid being sensible of

of the stroke at once, It is to that porpose as a solid, w^{ch} I may Remember was ob= served to Receiv y^{e} Influence of y^{e} Impuls by strait lines, and Instantaneously. this Radiated Influence thro all a fluid from y^{e} place of a Stroke, May If one pleaseth be called Ray's, ffor when I use y^{e} word Ray I shall Mean Nothing Els; and surely Not any reall thing Emitted from y^{e} Stroke, besides the medium, and the Effect of Impuls, In y^{e} ordinary way upon it.

It agrees with y^{e} notion of Rays.

If the sides of this vessel, any animall or other thing Natant In it, be Capable to yeild to y^{e} force of such strokes, they appear In an actuall giving way, as, at the capillary vent, I Noted. but If all be solid, and there be no yeilding at all, then this Motion turnes to a tendency, that is Would Move If there were way, as If the strokes are Re= peated divers times, y^{e} vent being stopt, there is No Motion but as medium, vessell, & the fulciment also Move. but there is a tendency of y^{e} medium to Move In such way as would take place, if It Might be, and would appear, If y^{e} vent were freed. so that as y^{e} Motion is, so is y^{e} tendency In all modes whatever; If y^{e} Motion would be In strait lines, y^{e} tendency, w^{ch} is but a Rea= dyness to move so, will be In the same

If no vent or yeil= ding, and strokes are Continued they become what is called tendency, or continuall Caus If the subject were p^{r}pared.

Hence

what would be
true of Motion
is so of tendency
ffor y^t^ is proved by
and is in truth
Nothing till it is
Motion.

Hence wee Shall readily affirme of meer ten=
dency, the same as would be true of motion,
and No Mistake ffollow, becaus it is declared
as before, to be no motion, but supposition of
motion just as it will, when it may be. And so
wee Mean Not that tendency hath any Effect,
as when such strokes upon y^e^ watry surface, hath
no effect upon y^e^ Sides of y^e^ vessell, but put in an
animall with organ's adapted, to Receiv Impres=
Sion, that is to be moved by y^e^ Consequence of
Such strokes, then it is Motion, and that onely
wee mean by tendency. And so long as such
Strokes Continue, wee say, there are Ray's
or Influency, that tend as often from y^e^
place stricken, every way as y^e^ Medium will
lead them In strait lines. And as the opticitians
fancy, Ray's of light as capillary Emanations
moving strait from y^e^ luminary. so wee will
here be so free, to say that upon Every stroke
There are ray's of force from y^e^ place, directed
to Every part of y^e^ Medium strait, Impelling
it. and thus by y^e^ Conduct if this Image, I hope
to make the one sort Explaine y^e^ other.

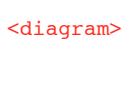
Influences must
Reflect from ob=
stacles, by y^e^ [....?]
of Impulses. vis^t^
Ang. Incidence =
ang. Reflection.

Now If wee may Suppose, a point of y^e^ vessell
on w^ch^ a Raye falls, to have the nature of a
Spring, that is to yeild somewhat, and then
Repercuss y^e^ force. the direction of Such Reper=
=cussion

=cussion must be according to ye laws of Re=
flection, that is, ye ang. Incidence, Equall to
ye Ang. of Reflection. And the Same thing will
happen If the spring be Infinitely strong, wch
is Coincident without Hypothesis, according to
wch, Impenetrability In ye Greater body, is a
caus of Reflection, No less then If it were a
<diagram> Spring. And it is demonstrated In a Case of
simple Motion. As If the body D. Rested agt
an Infinite Resistance at A. And were struck
with a larger body at. B. upon this stroke
D. shall move as It would, If united to B.
It had Struck at. A. that is as to ye following
direction, as for velocity's they have other
Consideration's. And In that case D. shall
move after ye Rule of Reflection towards
C. Nay If the Stroke were direct as at D. In
ye perpendicular. D. would Not rest after ye
stroke, but Reflect towards ye force. all this
is Consequent of what hath bin before
shewed, and particularly the rule, that e=
=very percussion makes a Repercussion.

These Reflections
are to and fro
as light.

From hence it ffollows, that In ye vessell of
water, the Rays of force doe Not dye at ye
sides, but Reflect according to Rule, and
so too and againe Every /way\ ad Infinitum (ffor
force Never dys.) as ye forme of ye vessell and
the



the position of ye Minute parts, on wch the
Extremity of ye Ray's fall. this May be Ex=
plained, as let. A.B. be ye vessell, ye Stroke
at A. the Rays going by right lines, can Ne=
ver affect an animall at. a. becaus there is
a solid. yt Interposeth. but a direct Ray Re=
flected from B. to. C. & so to A. Shall affect
it. And If ye solid. a. were Excavate, with
a foranimule Into it, the Strem would
tho so covered, start upon ye Strokes on ye
Exterior surface. And the Influence passing, as
it doth by strait lines Cannot Come there but
by Such Reflections. Now If ye Sides of ye vessel are
levigated or [plaine?], all paralell ray's, will
Reflect paralell, as light upon a looking glass,
but Rays from a point, will diverg, and If
the forme be oval, arcuate, or otherwise, ye
Rays of force, as those of light, will have a
cours accordingly. But If ye sides are Composed
of parts lying confusedly, and of accidentall
formes, then ye Ray's are throwne here & there
so as No place is free from them; as ordinary
coloured objects seen by Refection, are to be
discerned Indifferently from Every part. And if
an animall perceives by a Reflected Ray, he
must take ye force to Come from ye Reflecting
point, and Not ye point of ye force, as objects
in

~~As~~ In a Glass, are Not seen /as\ from y^e^ true place
but by y^e^ Cast Raye, as If they were within or
behind y^e^ Glass. And all that I have sayd here
of this Influence of strokes upon y^e^ Surface
of water, supposing Some yeilding so as y^e^
force Makes actuall Impression, I Shall p^r^Sume
to Say of tendency, for Reasons already Given.

<diagram>

This tendency of the force of strokes thro a
fluid Medium, hath other property's of locall
Motion. ffor If a Current from A. passeth Neer
a fixt solid. C. It shall Not touch it, but
break off before, and bending about the poin[t?]
fall Into Cours againe. W^ch^ depends on what I
observed of body's moving against a fluid
or a fluid ag^t^ them. the front is Screened by
some some of y^e^ fluid y^t^ is lodged against it, and
so the fluid break's aside. And accordingly
the Ray's of force, passing Strait neer an
obstacle, shall Not touch but Curb round y^e^
Exterior part, and so be put In disorder, but
fall in againe; ffor as actuall movement
would be so is all Influence of motion, and
tendency. this consequence with divers others
are observed to attend y^e^ passage of light, as
~~hath bin observed~~ /~~as~~\ by S^r^. Is. N. & others, wh[ere?]
It may be mett with. so it is If a current [thus?]
passeth

passage of fluids
as In currents ag^t^
obstacles, sheweth
y^e^ Manner of the
Influences of
strokes or of light
passing by or thro
Solids, parted asunder

If thro angular foramina the Influence spreads Into cilindricall forme, as light plainely shews.

Passeth thro a Quadrant or triangular fo=
rmen, It will soon becom cilinsricall.
In w^ch^ figure y^e^ parts conforme with y^e^ Medium
and themselves most, and so by y^e^ Many
agitations of them, the angles Grow blunt, &
at length are lost. In like manner this
Influence passing thro such foramen by
Strait lines, Shall be disturbed by y^e^ Solid. &
take such cilindricall forme, w^ch^ I cannot
well prove nor should have thought of, but
ffor y^e^ Manifestation of it In y^e^ passage of
light. when Glass in church windoes is broke
observe y^e^ formes projected from y^e^ Sun on
y^e^ opposite wall, and they shall Ever be
found to be round, & Never angular, as
the foramina are.

Such Influence of strokes, will be obnoxious to all rules of y^e^ perspective art, as light is

I may with Confidence also affirme, that
all the consequences, w^ch^ y^e^ art of perspec=
tive deals in, are applicable to the Influ=
ence of such strokes, or y^e^ ray's of force
from them; becaus those consist In Magni=
tudes, and strait lines /& Geometrick consequences of them\
as may be Explained
If I undertake y^e^ Subject of arts; And Re=
garding onely y^e^ passage of light, there
is Not one mode or Circumstance of it
but is applicable, to this Influence of
strokes on y^e^ Surface of water. I have
shewed

42. Fantasmes.

Shewed it In Most I can thinck of and par=
ticularly Reflection; It Remaines to consider
The case of Re= the Case of Refraction, w^{ch} is the Most conSide=
traction adum= rable phenomenon of light. And ffor Explai=
brated, by water ning this, I must Inlarg my Supposition and
Repleat with Spung. ffill my vessell with some loos stuff. I thinck
spung will be most aggreable. therefore
let the cisterne or pool, be full of spung
swelled to y^{e} utmost & filled with water.
I say that the Influence of strokes /layd\ upon the
Surface of this watery body, notwithstan=/ding\
the Substance of the Spung, will have a
Rectilinear ~~Infuence on~~ /direction or cours to\ y^{e} Sides.
ffor y^{e} Spung
The Influence of being an uniforme body, as y^{e} water it self
such stroke's will is an uniforme mixture, what one thing
be rectilinear putt's aside, another sets right, so In y^{e} Who[le?]
y^{e} Spung, being as the Result is Equivalent to Rectilinear.
y^{e} water, uniforme ffor an uniforme mixture of Irregularity's,
amounts to Regularity.

A current of To come neeerer to the Sensible, let us Imagin,
water thro spung that a Current of some liquid past thro
tho by anfractuous a spung, as If the bottom of a cisterne of
passages, yet water were of that Nature: where y^{e} weight
hath a Rectinline= of y^{e} Superior water would drive thro the
ar Cours Rest, with no litle Expedition; that current
thro y^{e} body of y^{e} Spung, however anfractu[=?]
ous the passages were, would be directed In

a

a perpendicular, that is a strait Cours, but as
to the perpendicular, it is to be accounted
as other plumbs, Converging towards y^e^
center of y^e^ Earth, & Not In paralellisme as
as to our contractedness seems. but that is the
direction w^ch^ y^e^ Strokes, Causing gravity, produ=
ceth; And so when a stroke is layd on the
The surface of water, the direction of the
Ray's, as I p^r^sume to call them is diverging
from the place, as from a center. And the
~~straitness~~ /rectitude\ of the Cours of them is Imputed
onely
to y^e^ uniformity of mixture In y^e^ Medium. but
If there were two Mediums of different Mixture
as Oyle upon water, I cannot Say there the
process would be strait, but be diverted, by oc=
curs with somewhat, w^ch^ creates a new and
different manner of passage. so the former
cours is disturbed, till the uniformity of
composition In y^e^ second creates a strait Cours
againe, but that Cannot be continued of
the former strait, Growing out of the dis=
turbance; as the other terminated In it.
And so is Refraction /of light\ w^ch^ shews as an angu=
lar fracture, but is Not so, as late vertuosi
observe, but rather Compassing; that is there
is a confusion & disorder at y^e^ passage between
one Method & y^e^ other, but for y^e^ Same reason
y^e^ Cours is strait, In one, It soon becomes so in y^e^ other
medium.

The Spung Re=
present's y^e^ Medium
of light passing
and If a difforme
body of Spung
were plas't ag^t^
y^e^ other, y^e^ Influ=
ence of y^e^ strokes
might divert
at y^e^ Entrance of
that. for as y^e^
uniformity of
y^e^ Medium makes
y^e^ Ray's strait, so
a difformity di=
verts or Refracts
them.

44. Fantasmes.

Water moving by Gravity Not a fit Instance, becaus y^t is a continuall direction way, but some other Current free to take any direction.

wee cannot take a parralell for Refraction from Gravity, becaus that is an action Ever Renewing, and Not flowing from some one force, as wee suppose our strokes upon y^e Wa= ter to be; and as light is an action propa= gated from a force In y^e luminary. therefore abstracting Gravity, and supposing a Current of water thro a body of spung all of a peice and In Every Respect alike; and there is another peice of Spung annext or Joyned to it, of another sort, but Either finer or courser grained, but In it self all alike. there is No doubdt but the water meeting this difforme Spung, must be disordered In the Current of it. And Such Cours as the Wa= ter happen's, from y^e manner of this new su= perficies, to take, It will proceed strait In that If the superficies be square to y^e Current, there will be onely a disorder, and then a continuation of the same direction, for No= thing can generally Incline it one way More then another. but If y^e Superficies lye oblique, then It is so farr from strang that the strait Current is diverted, that It is [$\div$?] consequence must happen; as when a single body moves, and strikes obliq upon another, It must be diverted from its Cours.

Here I must Recurr to What was sayd before
of Refraction, when y^e discours was of ~~Simple~~ /~~easy~~\
~~body's Impelling~~ /simple motion. that\ there is No reall
Refraction consi= diffe=
dered In the sim= rence between Refraction & Reflection; the
plicity ~~vide~~[334] of y^e former hath more force to proceed, & is less
part's as may be diverted. And what was y^e Rule of simple Im=
Concerned In it. puls, will governe all complex action's, w^ch
vis^t. a Speeces of are composed of simples, and Confused onely
Reflection. to us, that have not faculty's to distinguish.
Therefore let us take an Instance of that
sort. there is a surface, D.B. permeable
by a Moving ~~sort~~ /aggregate\ of body's. A. these may either
<diagram> Reflect or Refract /but comonly both\ ffor If the body's
fall on the
exterior part's of the Superficies; then they Reflect
to it. iff they pass touching a side at the En=
trance, they are diverted to. E. and And it is ob=
served In the Case of light, there Never is
Refraction without Reflection. ffor Some ray's
will fall on the solids directly, & those ne=
In great obliquity ver pass but Reflect. And In this diagram
there is No entrance It is obvious to see, that If the obliquity be
of Ray's to Refract very Great No ray's can pass to Refract but
but all Reflect. all Reflect. as also that In a Cours perpen=
dicular to the Surface, there can be No Refrac=
tion, tho there May be Reflection, ffor the
body's Must pass clear or Not at all.

But

---

[334] The word '*vide*' struck out here is in the same paler ink as the text, and was evidently written before the marginalium which has been written around it.

46. Fantasmes

Refraction from rare to dens is to &, & Econtra from ye perpend:

<diagram>[335]

The reason is the dens obstructs & hinders more ye passage strait on ye Rare opens ye passages & Makes 'em more Easy.

But there is a different Manner of Refrac[=?]
tion, as sometimes towards the perpendicu=
lar, wch is the Case of a body more dense, as
out of air Into water, and the contrary out
of water Into air. so that density Refracts /towards\ &
more rarity, from the perpendicular, as
let h.g. be a Superficies of a more dens body
towards. f. as water for Instance. and E.f. the
perpendicular. If the motion be from a /ye dens to rare\
the
Refraction will be /from ye perpendicular\ towards. d. &
Not towards [c?].
but If the movement be from d.b. or [c?]. from
rare to dens, It is otherwise as, If it be from
d, the Refraction Shall be to. a. It is obser=
vable that this is the same Cours, whither ye
movement be from one or other, as ~~Ifrom~~ If
from a. It is to d, & If from d. it is to a. one
ye Revers of the other. But the caus of this de=
pends so on ye forme & texture of these surfaces
and how they close, that one Cannot adven=
ture to say how this comes to pass. let us take
to our Imagination of Spunges. The Current of
water passing from the thinner into that
more dens finds obstruction and Crowds it
self more, but In the other Case, it passeth
with less difficulty, and would carry more
If it were there. this is all the reall difference
I can find; and I beleev the consequence
is

[335] This diagram is still in pencil.

is from thence, but how, I cannot say. So here is a Non plus ultra[336] in philosofy, w^ch concludes not onely knowledg, but conjecture, or thought of probability; If it Appears that such event may be by Mechanisme, without Necessity of Inventing (pardon y^e Expression) unknowne powers, to stop y^e Gap, it is y^e utmost of our aim, In this particular.

What will happen to Currents, will be alike to all tendency's, w^ch are as was sayd y^e Same thing.

All that here is say'd of actuall Currents, is applicable to those starts, w^ch are Caused by strokes on a fluid body, and have bin so much Explained. ffor y^e laws of Motion are y^e Same one way, and other; whither a currrent move slow, or swift, ffor the difference is No otherwise. The Influence of a stroke is but as the beginning of a Movement, and when it hath Effect, as upon any yeilding thing, whereby also animalls perceiv such actions It is but just Motion. ffor If a fluid were free, as dry sand is, and had No principle of cohesion or union, a stroke would dissipate all manner of way's, but being as I Suppose Inclosed, It cannot dissipate by such strokes but If Nothing yeild to them, then it is but tendency, and when there is yeilding It is Mo= vement; but the tendency being a p^r^paration or readyness to a certein Movement, ~~wee~~

~~take~~

[336] i.e., '(there is) nothing further, or beyond'.

48. Fantasmes,

wee take a freedome to say, the body tends or hath a tendency In such and Such Manner, and without offence, being so pr= viously Explained. And thus I thinck the puzle Made by Cartesius with his conatus ad Motum[337] is dissolved. ffor If It be Not understood of Reall Motion, when there is any Effect of it, It is Nonsence. but being understood, as I venture to Repeat, that It is a Constant preparation or readiness to Caus an effect, when obstacles are Re= moved wch hinder it.

Note
Tendency In ye simplicity, is When a force falls on a a body, and that is Impeded by one much greater; and then that motion ye less would have If Not Impeded is ye tendency of it when it is Impe= ded.

Now to apply all this discours, to the case of light, I hold, that there are Innumerable strokes made by the matter of Every lumi[=?] nary, upon ye ~~our~~ ambient medium; wch have an Instantaneous Effect (or very Near[=?] ly so) to Infinite Every way perpetually deminishing, In progression of sphears, an[d?] when animalls with organ's, capable of be[=?] ing Impres't by it, to a degree, as, accor[=?] ding to ye Constitution of the Creature, is pe[r?] ceived, and as wee feel in our Eyes, It is Called light. How this force Happens, or may possibly be, remaines to be shewed, and being no slight paradox, will need Much care & distinction.

Light is ye Effect of Innumerable strokes by ye Minute parts of ye luminary on ye Minute parts of ye Medium, & so propagated by Con= tinuall contigui ty of matter thro all ye Rest.

---

[337] i.e., 'the tendency to movement'. Descartes had rejected the scholastic notion of '*conatus*' as an 'inclining to movement' (as if were an an act of will by objects). He developed a materialist theory of motion (which was 'materialistic' except that it required God to set all in motion - thereafter the rules worked). Descartes explained his laws of nature (which include the 'puzle' to which RN here refers) in the *Principia philosophiae*, Elsevier, Amsterdam, 1644, II, 36-9 (*see* http://la.wikisource.org/wiki/Principia_philosophiae). For an English transcription of the text *see* http://www.earlymoderntexts.com/pdfs/descartes1644.pdf.

The caus of Such Strokes, is the Same as of fire, or rather the con= Sequence of fire.

We shall for this, lean much on the Con= stitution of fire, for I thinck Every origi= nall luminary, is fire; and Even corus= cation's, as rotten wood, & fish in ye Night are such, in a low degree; but wee medle Not with those yet, having More Regard to ye Grand luminary ye Sun, and If wee Can Reconcile that to our porpose ye Rest will be Easy; But yet wee must consider all to= gether.

The body of ye sun is fire.

The body of ye sun is concluded by all astro= nomicall Naturalists to be a Globe all, or much ye Greater part fire; as for ye Maculae [338] whither they be fewell or cinder's, Matters not, they Come & Goe, and fill a very small share of ye Disk. and It is Not unlikely, but If wee were In a distinguishing distance the Sun would Not appear to be so pure a fire as /seems\ to our Sight, ~~appears~~. but disturbed & tumultuous, full of Eruption' Explosion's Grosser & ffiner ffiry matter Rolling about. of wch wee Shall In larg, coming to consider

Where fire is there is a Strife of pres= sure between ye. Medium & ye fire, Els ye fire dissipates.

ye Nature of fire wch is Not of this place. it is Enough to say here in generall, that wherever fire is, there is a pressure of ye /ambient\ Medium upon it, and alternately, a strife

[338] i.e., Sunspots; much of RN's life was passed during the Maunder Minimum (1645-1715) when sunspot activity was at a low.

strife on ye part of the fire against it, tending
to dilate and dispers; As to ye Sun, this is
derived from the Recess of the aeriall matter,
/of\ wch yt /is ye grosser or\ most Inept to swift motion, /
works\ towards
the Exterior part's of the solar sphear, and
consequently the smaller and apter to ye
swift agitation of fire, works towards ye Sun,
and So is ~~Quasi~~ a perpetuall pabulum to
ye fire. In like manner a Candle, is prest upon
by ye air, with ye whole force of ye air-Sphear,
(ffor I take flame to be a Torricellian vacuity)
And all fire is a Rarefaction that tends to Ex=
pansion, & would Expand, If Not kept toge=
ther by some such pressure as I have described.
A burning Coal, perpetually breath's out a
Rarefyed matter from ye Interstices of ye Wood
wch is as flame, a vacuity, and Spends as
flame In smoak, and So mixes with the air.
This pressure & Repressure is the Caus of light
ffor ye Repuls of fire upon ye Medium ambient
about it, makes a tremolous Motion (but
Incredibly swift Every way about, wea=
kening by distance, but Never /wholly\ Evanescent
So that If I can Shew that ye matter of the
world is so struck upon, by ye surface of
the sun, ye Motion must Come to us, and
wee having, organ's adapted proportionately
for ye porpose, wee perceiv & call it light.

This action and
Reaction about
fire made by small
sttrokes, is In Sume
a tremolous action
In ye medium wch
spreads & demi=
nisheth but is Ne=
ver Evanescent

The conatus ad motum of Car= tesius, as to y^e caus of light Rejected.

Here I Reject the sentiment of Cartesius, who would needs have the Recess from y^e Center of the Globolous Ether, to be y^e Caus of light; ffor It is In no Sort adequate, and I shall give but one Reason, w^ch is light must be a tremolous force, Els y^e object Could Not have a Continu= ing Image In y^e Same ~~Matter~~ Manner; If the sence of the light was from crouding onely If y^e organ once yeilded there was an End, and the sence might perceive somewhat of a Stroke but Not a Continuing Image, as light is.

The caus of light is a tremolus motion w^ch a conatus cannot be.

This caus of light is wonderfull, & difficult to con= ceiv.

But to proceed with our owne designe, and Remove the herculean difficulty's that at= tend it. It May be asked whither the action of the luminary against y^e ambient fluid, be not In Effect such a Crowding, as y^e Conatus of Cartesius, & lyable to y^e Same objection? I answer No. the Rarefaction or Expansion of y^e fiery matter, Is from y^e Motion of y^e Minute parts, and those striking upon the fluid, ~~is~~/are\ so Many Impulses, where of y^e Influence Rea= cheth to us. So wee have this paradox to maintaine. light is the Sume of force, flowing from y^e Impuls of the Minute firy parts on the ambient fluid Surface, & so propagated Every way. one may ask, doth the force, of Every Inconceivable part of matter, on so vast a

body

Strokes may not be perceived If Separate, but u= nited become a Gross object of Sence and Such are the consequence of fire.

body as ly's between us & ye Sun, Make a sensible Impression upon our organ? I ansr, If separately taken, Not, but with united fforce, they doe make such Impression, and With a violence to ye organ, /as\ None is unacquainted with. The stroke of such a particle on such a body, is /yet\ somewhat, and /as I sayd of all Impulses\ Extends an Influence ad Infinitum, but is collated with ye Capacity of our opticks, (however Nature hath No limits,) /it\ is ~~once~~ Inconsiderable, and May Justly be Re= puted as Nothing. How then these Insensibles multiplyed become Sensible? I ansr, Most Ne= cessarily; ffor whatever ye Strength is, a combination of such, makes a strength Much greater then /any of\ ye Individualls make, As one candle may be seen a furlong, 2. farther, and More, shall be seen divers leagues ~~where~~ /at wch distance\ one, candle was not /at all\ discernable; & yet all this was but Candlelight. So at the sun, the stroke of one particle is Nothing to us; /of\ 2. /comes\ neerer /the\ being perceived, but yet farr Enough from it. /then of\ 3. 4. &c. to such Numberless miriads of miriads as are made by ye Suns surface, that is by ye Severall particles of it Cooperating to ye Same effect. So Many as according to ye Comparison ~~to/~~wth\ Candles, may be allowed to make a strong Impression on our organ, and answer ye proportion.

This motion Excited by the agitated Surface of fire, cannot be other then tremoulous, becaus the strokes are not all at once, and so ceas, & againe. but Continually applyed, & with frequency, Inexpressible. and the process of the movement, must follow y^e^ Nature of y^e^ caus, that is, be Composed of pulses, as the Caus had. Whither wee Can distinguish such pulses, or Not; /that\ alters Not their nature; ~~and~~ the Consequence is but this; that wee have an Idea of Continuity, tho y^e^ Subject is Composed of distinct, (tho Not by us distinguishable) Items. That this solution of light naturally agrees with most If Not all the /other\ circumstances of ~~light~~ /body by movements\ the particulars will demonstrate/. as

This motion Must be tremolous, and seem continued tho composed of pulses; And the concordance with light proved by Instances.

1. It comes, & act's by strait lines, w^ch^ shews us the places and Shapes of Every thing. ffor the figure of all visibles is described by a section of y^e^ visuall Cone, as the masters of perspective say. and Such I may account /to be at\ y^e^ ~~In~~/Ex\terior part /[~~or Section~~?]\ of the Eye, where the extremi=
ty of y^e^ Ray's, /[as?]\ terminated, deline /[all?]\ y^e^ Shapes
of objects /as they are\ obverted to y^e^ Eye; but that is Not
Enough, they enter y^e^ Eye, and by y^e^ Rules of Refraction are contracted, & by wonderfull artifice, layd upon y^e^ Retina, & there they are really terminatd, A sensible Impression being

The action dis= pers't by strait lines, and each puls hath its Ray

being Made by them there, by touches as to place
In very proportion, as ye object sends ye Ray's
wch gives us the Image of proportion ~~an~~ see=
ming magnitude of things. as for Colours I

The Influence crosseth Infinite way's, as light without confusion. a strong argument of truth.

Must take More time to Consider them. 2.
light ffrom all part's, pass to all parts, and
not onely so, but by reflection's, crossing, &
Recrossing with Infinite variety, and yet
neither ye Medium ye least disturbed, Nor ye
lights at all confused. It is bold to say this
cannot be otherwise, then according to our
hypothesis, therefore I forbear, & desire who
will may thinck of it, and Say If any Ema=
nation or actuall flowing of light, Into and
thro ye Medium, hath Not Irreconcileable dif=
ficultys, and If any /such difficultys\ are In this way of solving

3. All the modes of this action of light, as Reflecting &c, after ye Rules of corporeall Impuls.

the crossing of light. 3. The Reflection of
light is Exactly conforme to ye laws of Mo=
tive Impuls. And If light were an Emana=
tion and Not body, why Should ye Rules of
Body belong to it? If it be body, It cannot
be distinct from ye Medium. 4. light scatters

Light Imitates a current by scat= tering at the limits, & beco= ming round

In ye ambient medium, as a fluid current
thro another; and Imitates a Current, tho
It is None. however shaped ye foramen at wch
it passeth is, It shall become roundish, and
It shall bend round Solids, and Not break
sharp upon them. 5. light is a consequence

of

Fantasmes ~~28~~ ~~85~~

Light attends fire constantly, & that is ye most vi= olent of ferments, or motion's secun= dum partes.[339]

of fire, Wch is ye Most violent of Motion knowne to us, becaus it discerps hard body's, wch no other mean's wee have, Could doe So effectually, and soon; So that motion is the consequence of /motion and not\ Emanation: unless it be the feces or rather the Spume of fire, smoak, wch is farr Enough from causing the Idea of light. And the vivid Image yt light, doth In it self Resemble a sparkling motion, as when E= ery part of ye fiery surface, (and perhaps En= forced from ye body also,) act's upon ye Medium And producing Strength from ye Combination of all. The genius of this action, doth wonder= fully conforme to our sence of light. 5. light

Light is Instan= taneous, as such Influence is. and that small diffe= rence, observed In ye coming of light from ye Jovian sa= tellitts, is consis= tent

is Instantaneous, as the Influence of strokes is. Wee can make no Experiment yt proves ought otherwise. but ye late astronomers observe ye light of ye Satellit's of Jupiter, doth not appear till, ...[340] after their Emersion from an Eclips, as they calculate the same. And they affirme much Constancy In ye observation and argue from thence, that light is A process or successive Emanation from ye luminary. And there wee differ. Doubdtless thre is some failing In ye calculates, for what astrono= micall prdiction's ever proved Exact? and those, whatever they are, goe to the acco of time. but be it as they say, It follows not

[339] i.e., 'according to motion', this is a direct reference to the latin text of Descartes *Principia Philosophiae,* Elsevier, Amsterdam, II, 22, p. 53, (*see* http://la.wikisource.org/wiki/Principia_philosophiae). For an English transcription *see* note on f. 235.

[340] RN leaves a space here, to be filled in later.

In practis there is some Rupture, of Instantes, ye Rigor of wch is as other exactnes= ses, In hypothesi. but such happens from accidents of shapes, & positions wch tho there be a perpetuall Conti= guity, may caus a cession or yeil= ding In some degree, percepti= ble at such vast distance, but Justly accounted as No= thing Compared with it.

Then warmth at= tends light, wch argues a motion or action of ye Me= dium.

not, but our solution may stand. ffor when wee goe from speculation to practis there will be allwais a wide difference. there are actu= ally No such shapes as Mathematitians deal in, points, lines, squares cubes, Sphear[s?] &c. they are but Naturall possibilitys, and therefore may be prsumed; ~~and~~ so time hath its Instants, or Imaginary points, such as come between 'fore and after. and lines wch are ye duration of it. but a Real Instant is Not in ye World, unless it be among thing's meerly originall Such as wee take ye prince= ples of compound body to be, Intire and In= discerpable. the clashing & Separating of such, Must be Instantaneous. But I cannot Say it is so In any Case of Compound body clashing, becaus all compounds will yeild somewhat, and act as Spring's rather then by Meer force of hardness, wch gives time to the Separation. ffor whenever a thing goes and Returnes, there is an Interstitium of tim[e?] between ye one & ye other. But this is so In= considerable No sence of ours Catches it. Thus when one end of a staff is put fore= ward, wee Say ye other End moves In the Sam[e?] Instant, wch is sensibly but Not Mathemati[=?] cally true; ffor ye Matter yeilds somewhat

and

Fantasmes ~~29~~ ~~57~~.

[marg.][341] And so the motion at y^e^ farther end, is
not Exquisitely syncronous with y^e^ touch.
And If y^e^ Staff were a Mile or 10 Mile
long, & It were practicable, I beleeve, there
might be a time Intervening sensibly.
But what, If it reached from Edenburg to
London, or what is more to y^e^ porpose from
y^e^ Earth to y^e^ Satellit's. According to this, the
action of light May protrude y^e^ Whole Me=
dium, as wee Comonly say, at once, but In
truth, the accidents of shapes, motions, and
position's of things of w^ch^ it is made, may
break that Instant, by Some yeilding, w^ch^
In So vast a distance as to a satellite. And
yet this May be justly accounted as Nothing
ffor what is a. 2^d^. of time, to that distance?
our Stroke upon a vessell of water, makes
the liquor at y^e^ vent Start; wee Say, as it
Seem's in y^e^ Same Instant; but there is reason
of parts, however Inconsiderable, yet Enough
to Infring y^e^ Nicety of a pure Instant. And Such
allowance made for distance between us. &
y^e^ Celestiall luminarys, May well produce
a few. 2^ds^. of time, w^ch^ compared ~~to~~/w^th^\ that /distance\
are /as\ Next to Nothing. And Notwithstanding that
wee may well account y^e^ action of light Instantaneous.

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[341] This marginalium, set sideways down the page:
'6. Whereever light is there is warmth, and that is agreed to be but Mo=
tion. This action, when it moves so strong as from y^e^ Sun, is sensible by y^e^
heat it Gives, and that is multiplyed by y^e^ Reflections about y^e^ Sun face of y^e^
Earth. but y^e^ warmth of Reflected light's Is Inconsiderable of themselves
as that of y^e^ Moon, tho Experiments might be made of it by concaves
And lesser lighs doe not affect us, as candles &c, without such helps.'

58. Fantasmes.

The objection of Improbability ans^{d}.

There is an enimy still behind & that is, /Im=\pro= bability. ffor, In y^{e} objectors language wee Ma[y?] Say, how is it to be Imagined that the whole body of the medium between us & y^{e} Sun, or y^{e} Much more distant starrs, should be put in to and kept in a tremolous motion, by y^{e} Stroke of Minute part's of matter? In ans^{r} to this I must propose farther to Consideration

The Medium of ~~fire~~ /light\ is the Inter= stitiall matter of the world.

the proper medium of light, w^{ch} is differen[t?] from that of sound, ffor sound Comes not at y^{e} Eye, nor doth penetrate solids, but will Incircle them; and that light will Not doe, passing allwais strait. Then fire, whence light proceeds, is of a subtile matter as all combustibles are. while Conglomerate, and Not agitated, the minuteness of y^{e} parts is Not to be discovered, but the being obnoxiou[s?] to swift Motion, peculiar to small things, it is conjectured. such matter, by y^{e} action of Gravity, as most yeilding, is driven downe to y^{e} Sun, and Such is y^{e} Matter about y^{e} Sur= face of it. And there it is the most, but far= ther from y^{e} Sun it is more broken & Inter= spers't, Residing In y^{e} Interstices of Grosser matter. and that is y^{e} Case of our air, w^{ch} is like feathers or wool to this finer Mat[=?] ter that is amongst it; And by this finer

matter

matter by w^ch^ most liquors, & all pellucid
body's are with litle disturbance permeable,
the action of light is Conveyed. And however
the Grosser is also affected, but not so as to
affect our organ of sight, w^ch^ It doth Not
penetrate, unless It affect us by heat ex=
ternally, as y^e^ consequence of light. but this
Comes Not to y^e^ point. how such small strokes
can Move Immens matter, so as Wee Shall
perceiv it. ffirst as to y^e^ exility of y^e^ movent
body, I ans^r^ It by Number, as before. but as
to y^e^ vastness of y^e^ body Moved; I ans^r^, If it
be moved In any degree, I ask No More. and
That hath bin all along Insisted on, & I
thinck is Not to be denyed, that all Motion
Influences all space, (admitting plenitude)
and there are no limits of Motive Energy
but whatever is sayd for y^e^ Continuance of
it a yard, hold for 2. 3, &c. and So to Grea=
ter then any space ~~assiglable~~ assignable. then
this action of fiery matter on y^e^ ambient Me=
dium, being Somewhat In all distance /tho continually
decreasing\; be
y^e^ place or distance where you will choos,
I say y^e^ organ is Nice, as y^e^ Influence is Weak.
and as Nothing limitts the process of y^e^ Influences
of light, so Nothing Confines the power of
seeing

Exility ans^d^. by
Number, and then
by niceness of Sence
ffor If y^e^ action
be any thing
however slight
y^e^ Sence may be
yet as Nice as
that is slight
who Confines
Either?

Seing; So this wonderment vanisheth, as all other admration that belong's to ~~Magnitude~~ /Immensity\ or Exility, /ffor such\ are but Ideas of defect, growing out of Comparison, with o^{r}Selves. ffor as ~~all~~ Magni= tude is ~~y^{e} Same~~ /Indifferent\, and proportion onely fixeth it, So all force is ~~y^{e} Same~~ /alike\, when Capacity bears proportion, according to Measure of it. And the most Inconsiderable Impuls is Great upon a body much less then it self, and a minute

The eye In Every Respect disposed ffor Niceness of touch, and to Ga= ther force from y^{e} action of y^{e} Medium.

action, is Gross, If a capacity comes with a Nicety as to be so Much more subject to it. And what can be Imagined more Nice of touch then y^{e} Eye; Neer y^{e} seat of sence, The very strings of communication terminated, & layd bare in the Retina; Humors ever there In plenty to conserve the tenderness of them and lastly, the artifice of y^{e} Eye is such, as Con= tract's the force into a less compass, p^{r}serving the distinction of y^{e} object, whereby it is Im= prest with more Efficacy. All w^{ch} taken to= gether Shew a provision made to Receiv a

The wonder of light is not y^{e} mode of such action as is y^{e} Caus of it, & y^{e} seeming slightness of it, but the Effect It hath on y^{e} Imagination

very slender Impression, as that of light is If wee Examine it by any other mean's of perception than y^{e} Eye; ffor otherwise It is wholly unperceivable; I Grant there is won= der enough In it, but It is Not In the Movem^{t} and its exility, but In the organ of sence & the

the capacity of animalls, together with y^e^ sublime Image it gives us of y^e^ world, and all by mean's of most admirable artifice, and disposition of y^e^ organ. And this I have thought as to y^e^ Mechanicall Caus of light In ge= nerall.

Colours are but various modes of this action, w^ch^ are Not percep= tible, in such Inconceivable exility.

But The Grand difficulty ly's be-hind w^ch^ is to give an acc^o^ of the modification's of light such as wee Call Colours. I Should have Made No Scruple to assert the variety of Colours to be Nothing Els, but Ideas caused by y^e^ various manners of the action of ~~the~~ light, that is Modes of it. And Why this is red, that blew, &c. to be wholly unaccountable, be= caus it Impossibe to anatomise y^e^ pulsatory action w^ch^ gives us those Ideas. But It is Easy to Imagin variety Enough, as the texture and disposition of compound body's and their parts may be, as also the Super= ficies of them, whither pellucid or Not, to.

The like diffi= culty had bin, as to sound, If wee had Not acciden= tally found Mean's to anatomise har= mony.

answer all those variety's. As to Instance In sound If wee knew onely that sound consists of swift pulses upon y^e^ drum of y^e^ Ear, without any Musicall Experience or anatomicall Resolution of harmony as wee gaine by undoubdted proofs, Shewing

y^e^

the proportion's of the (Indistinguishable
pulses In y^e measure or time of them; that
answere all knowne harmony. yet Wee
Might have Reasonably Concluded; that
the variety's Wee perceived In sounds, as
nois, tone, harmony, discord, & y^e severall
Specie's of each, proceeded, from y^e various
modes of those pulses; And that as many
way's, as the pulses are diversifyable so
many severall & different sounds Might be
perceived; altho wee did Not know w^ch belon[=?]
ged to w^ch, as In many sort's of Sounds wee
doe, Especially Harmony. Wee are under this
Whither is is rea= Sort of Ignorance, & Invincible, I fear, In
sonable to Expect the Matter of light & Colours. wee can I=
such an anatomy of magin diversifications enough In y^e action,
light & colours but cannot collate, those diversity's with
is doubdted. our Idea's occasioned by them. And whither
wee May hope such fruit of our faculty[s?]
as by any future helps of discovery's wee
have any reason to hope for it, or Not,
I will Not say, ffor it is In vain to des=
pair, and More vain to Expect a happy=
ness In philosofy, so Remote. So that being
at y^e End of our Cours, that is from things cer[=?]
tain, to probable, & y^e degrees of it, & at length
to meerly possible, and In that /both\ clear &
dubious

dubious, wee must Rest, and Suppose wee are
at a Non plus ultra.

S^r^. Is. N^s^. disco=
very's about light
& colours; whence
he argues colours
to be specifick &
heterogene ray's, &
light to Consist of
all together, and
Refraction to dis=
play, by severing
them In different
Angles.

But wee are alarmed here by some ob=
servation's and Experiments about light &
Colours, published by S^r^. Is. Newton. w^ch^ un=
der y^e^ flattery of ~~Shewing~~ New Eclarisement
In that subject, hath Introduced More Ig=
norance & Mistery then wee were aware
off. And under y^e^ disguise of declining all
hypotheses, & professing onely Naturall
history /yet he\ Sets up an hipothesis upon prin=
ciples, of w^ch^ Nothing is seen, felt, or under=
stood. The Invention is, that when light
is Refracted, by passing obliq thro a Me=
dium of a different Consistence, Divers Colours
are projected in an order as layd with a
pencill, and knowne to us by the disposi=
tion of y^e^ Rain-bow; therefore needs No far=
ther description; And this order is Constant
& universall, And by diver's Experiments
hath proved Not onely y^e^ order, but the spa=
ces proportionably, as they ffill, w^ch^ distin=
guishing by the more Notorious periods of
y^e^ Colours, he hath found that they are to
Each other, as y^e^ Spaces of y^e^ Monochord de=
vided so as to produce y^e^ diatonick scale /in musick\

A hint there of
light & harmony
derived from one
comon principle
but Groundless.

or

or, to give a more familiar description
then he uses, as y^e^ Spaces between y^e^ fretts, on
y^e^ finger-board of a base viol. by w^ch^ he
Would Insinuate Some tremolous Measures
In light conforme to Musick, as If one prin[=?]
ciple In Nature goverened both. but this I lay
aside as a fancy, without any foundation,
ffor what hath the spaces of Refracted Colour,
to doe, with y^e^ monochord, or aliquot parts.
And If accident makes y^e^ picture of y^e^ Colours
somewhat like the fretts of a musicall Instru[=?]
ment, w^ch^ by y^e^ way doe In No sort Resemble
y^e^ Motion of y^e^ air, Even In harmony, what
can be argued from thence. He observes also
that thin diafanous body's, have rows of
these Colours, as so many rainbows; with
many other finesses, best taken from the
Author himself.

Altho he Re=
nounceth all hy=
potheses, yet
here he fall's
Grosly Into one.
& Argues it as
consequentiall
from some expe=
riments.

Upon the whole, he raiseth an Hypothesis
In opposition to the Mechanick solution of
light, and Referring colours to different Mod[es?]
of it. ffor, Says he, It is plain, the severall Co=
lours are allwais Refracted In y^e^ Same angle,
some On Greater other's In less, orderly as
they are depictd. And If any one of those
Colours be again Refracted, or oftener, ther[e?]
are No New Colours produced, but that same

continues

continues without chang of hew thro all
Refraction's. from thence he Inferrs, that
light is Compound of ray's flowing from
y^e^ luminary, with Incredible Celerity. And

White a comon mixture of all co= lours, and Ray's are originally and pro= perly coloured.

that light being white, very Eminently
so, when Strong, as snow linnen &c, and
Grey or dusky when weak, or Inclining
to dark, ~~y^e^ Compound /is\ of ray's~~ the Ray's y^t^
[~~Guiv~~?] Give us that Idea of white, are a Mix=
ture or ~~ple~~ blending of divers /or all\ sorts Confused=
ly together. ffor Ray's are Qualifyed speci=
fically and originally, to give the Idea of
Colours, as sugar to create a sweet taste &
Colloquintida bitter. And If these Colorify
ing ray's, are separated, then wee see the
Colours, but If blended together they are
white, or whitish. Then another Quality of

Rays are Refran= gible to different Angles, allwais & unalterably so.

of Ray's is, that they are Refrangible, to a
certein angle, some more some less, so that
what In light is white, If Refracted is Co=
loured, becaus the Refraction separates &
Says apart y^e^ coloured ray's, by their diffe=
rent Refrangibility, w^ch^ In comon light were
all blended together. Now to Shew that
here are abundance of Revelation's, w^ch^
make science more obscure then clear, y^e^
Item's will shew.

65. Fantasmes.

The failings of this hypothesis. 1. No Emanations

2. No senc of y^e word Ray, but is taken from simi= litude to a Circle & its Radii of w^{ch} y^e luminary is y^e Center.

lect optic^{ae},[342]

D^r. B/ar\row's conceipt of Ray's, as para= lellipidenons; w^{ch} was to aid demon= stration, & Not as a phisicall truth.

1. It appear's not that there can be any flowing of Rays from y^e luminary, ~~but~~ rather that such process is Impossible. 2. There is No account what is meant by Ray's. ffor y^e word is but allusive to the radii of a circle and of it self, to y^e porpose of light, wholly Insignificantive, unless ~~that~~ /it be becaus\ light is Inter= cepted by Any opac body opposing in the strait, between y^e luminary, & y^e luminated and so the luminary is like a Center of a Sphear & y^e light like y^e Ray's from it to y^e Circumference. but I desire to know, after all this, what Image or Idea have wee, that ans^{rs} y^e word Ray? No other then a clowne hath that talks of y^e Sun-beams, and as much is understood by y^e one as by y^e other. D^r Barrow, Ingeniously enough, Supposed y^e Ray's of light to be as paralepipedons, [solid?] and Shews the directions Of such body's would answer light well Enough. but he was farr from Imposing of that otherwise then as a paralell, to make y^e action of light seem a litle familiar or probable to us, but Not as a phisicall truth. tho so farr he was right, that It being apparent light acted after y^e laws of body; So No Instance Explicite could be proposed to Explaine light but What was corporeall. Some have fancyed Rays of

[342] This marginalium (in the same ink as the main text) refers to Isaac Barrow's *Optical Lectures* (*see* note on f. 182v, above).

Fantasmes, ~~34~~ ~~66.~~[343]

some allude to painting & call parcell's of light pencills.

Rays of light to be capillary, and Call any determinate Quantity, a pencill, alluding to such as painters use. These are pretty allu= sions, but of No Instruction att all. Much less when ray's are talked of, without any account, or definition at all of them. 4. It is Much More Strang when there is No account of Ray's In generall, that Quality's should be assigned them. As that some Should have a Quality to Make us see blew, and others Redd, &c & a Mescolanza[344] of them all, white. that light it Self May be Coloured variously, is Not Strang, becaus It may be conveyed thro various me= dium's; but that any of it brings from y^e^ lu= minary originally, its proper hew, and as wood is distinguish't from Iron, maintiane its property, hath litle ground to lean upon.

4. how can proper= ty's be assigned to Ray's, when there is No Notion of Rays what they are?

Then the other Quality of Refrangibility, in various angles, whereby couler'd ray's are sorted to view, is altogether p^r^carious. as If the refrangibility were In the Ray, and were not Referred to y^e^ difforme superficies, & y^e^ obliquity of Entering Into it. Is is true y^e^ Co= lours are Caused by most Refraction's, And that they ly constantly In y^e^ Same order, &, /[neer?]\ Spaces. but how follow's it that this must pro= ceed from Refrangibility In y^e^ Ray's, when ~~not~~ Non Constat[345] of y^e^ Ray's themselves?

5. Refrangibility to different angles may be Referred to y^e^ body Refracting as well as to y^e^ Rays

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[343] This is the first of three pages that RN has numbered '66'.

[344] i.e., 'mixture' (from the Italian).

[345] i.e., 'not certain', that is 'we are not certain (of the existence, etc.)'.

66. Fantasmes.

no proof to say
wee know not how
it Can be otherwise
for that is No More
then, a know Not

And It is dark proof to Say, wee know not how it Can be otherwise, therefore it must be so. When it is shorter at once, to say the thing is Not understood, then to propose half a dozen precariety's, and It Come to the same at last. It is sayd, that

yᵉ Angles, of Re=
frangibility Con=
clude not.

a & B. &c. Refraction of the same Colour will not Chang it, but what is bredd by one Refraction, will be yᵉ Same thro all. be it so, but yᵉ consequence failes, ffor the Colours will be yᵉ Same, or Neerly so, In the first Refraction, tho the light have No white mixt with it but is purely Redd or blew as strong & true as any /such colour made by\ Refraction, as any one may discover by a prisme In a room lighted onely thro a Ruby or Glass Coloured. but I will Not contendhere of any Experi= ment but admitt all. And Still maintaine

The Mechanicall
Hypothesis hath
sure principles
this None

There is No Consequence to yᵉ porpose made. And as to that, and also some defect's In yᵉ Mechanicall hypothesis of light, Wᶜʰ are objected as fatall, I must alledg that If a solution be conformable to Nature and on sure principles, Such as /Resolve\ the giration of the planets; however all phenomena /perhaps\ May Not be Reconciled to it, yet it is Not to be Re= jected, and for this I alledg the authority

of the

The cours of the world may be concluded upon from Naturall conformity altho our manner of sensation doe Not lucibrate In Some Items. as Copernicus [...?]

of the Never-to-be-forgotten Copernicus ffor altho y^e^ planets ough according to their distances to have appeared Greater and less to ordinary view, as he thought, yet there was scarce any sensible difference In their appea= rant magnitudes. W^ch^ was an objection to his systeme of y^e^ heavens he could not ans^r^, and Not onely in a negative way, as a case not resolvable, but positively thwarting and with a face of demonstration arguing ag^t^ it. yet he saw so much of Nature (I know No bet= ter Expression) in that cours of the heavenly luminary's, that still he adhered to it, belee= ving there was some caus ffor that unaccoun= table appearance, w^ch^ was hid from him, & might In good time be discovered, rather then Resort to that Inextricable Machina= tion of Tolomee, of Resolving y^e^ heaven's by orbs and axes; This by Gassensus was accounted a manifestation of y^e^ Greatness of his Mind, that could discerne truth, in Gross, and slighted small thing's, as knowing that If wee were let into a most sure Intuition, of a true hypothesis, It was not Necessary to know Every circumstance of it.

A generall May be understood tho all y^e^ Incidents are not discove= red.

but some phainomena would Remaine w^ch^ would not be understood; ffor a case may be knowne, tho all the connexions and Consequences of it may Not be Revealed.

So.[346]

so it fell out with Copernicus, his reason carryed him ag^{t} y^{e} Evidence of his Eys, and he neither thought of a mean's by Glasses to obteine a Manifest solution of y^{e} difficulty Nor lived to the discovery of them. but after his death, y^{e} use of telescopes Came in, by w^{ch} It was found that the apparent Magnitud[e?] of y^{e} planets ~~what~~ was most accurately Con= forme to their distance. and that it was y^{e} humidity & humours /of\ ~~about y^{e}~~ Eye, w^{ch} made a sort of adventitious light about the~~m~~ /starrs\, Whe[n?] Seen with y^{e} bare Eye; w^{ch} telescopes pared away. & Shewed y^{e} terminated body of y^{e} plane[ts?] In true perspective.

Our solution of light is founded on certein and knowne principles. What if all In= cidents are Not yet understood.

I May Resemble o^{r} Case to that of the pla[=?] nets, In y^{e} time, and apprehension of Coperni[=?] cus; that is that Wee have a plaine and naturall solution of light by the beating of the luminary, & y^{e} Minute part's of it upon the medium. a force that certeinly doth Ex= ist, and y^{e} onely Question is, If our organ be Nice enough to take it, and It be that w^{ch} affec[ts?] our sight. No say the modernes, ~~you~~ It can= not be that, ffor you doe Not shew mee, Why Refraction's are so Regulatd, and how Colour[s?] are consequentiall. be it so; yet y^{e} reason is not good, for a defect of application to a particular

[346] 'So' is written in the same ink as the main text - it seems to be a false start to the page.

Defect of applic= cation to a parti= cular Incident doth Not Impeach yᵉ Generall.

particular matter, doth Not Impeach the ge= nerall, becaus there may be somewhat singu= lar In certein particulars, to make a diversity not understood, but such, as future discoverys may Explain, & make a connexion of all, as happened from telescopes, in yᵉ Case of yᵉ planets. And this hath less objection then that; ffor the appearance contradicted the assertion; If neer, larger, If farther off, less; so all will agree, but yᵉ planets appeared yᵉ Same In all distances tho so vastly Extended asunder. but here No=

This solution of light, is Not contra= dictory to any knowne Instance of Naturall Movemᵗ.

thing contradict's, ffor None can say but It is possible in Nature, that a tremolous action of yᵉ Medium diversifyed, may create in us yᵉ Idea of Colours; but Wee know Not how, colours are Not incompatible with Such Caus, or Inconsistent with it. And perhaps yᵉ Man= ner how, not yet knowne May be discovered.

conclude with a Sumary of the so= lution it Self

I shall Conclude this branch with yᵉ Sume of all this discours concerning /light &\ colours, that the action of yᵉ luminary causeth a conso= nant action of yᵉ subtile part of yᵉ medium being most obnoxious to it, And that falling with advantage on yᵉ Retina of yᵉ Eye, creates in us yᵉ Idea of light; and the diversitys of this action, whither originally from some= what Singular In yᵉ luminary, or distur= bance, In yᵉ Way, is discovered by our Idea

of

of various colours. And such Images being all
of Confusion, becaus wee have No sort of dis=
covery of the minutes, In ye action of light; the[re?]
is No Resemblance, between ye Image and the
thing; wherefore light & colours, as wee I=
magine them, are not In ye object but In the
Imagination; And Nothing is to be found In
ye object but Corporeal action.

Farther Consi=
deration of Sr
Is N. Referred
to Exp.

I have farther to Consider of Sr. Is. Ns. prooffs
against Colouration being a mode of light,
as also, what may be farther alleged that
they are such and No other; but this needs som[e?]
Experiment's to be made, and due Canvasing
of ye Whole theory, as may be done by a Supple[=?]
ment here; for wch ye ~~lak~~ lacune is kept.

~~Sound~~.Fantasmes ~~37~~ ~~71~~.

The Mechanisme of Sounds depends wholly on the Spring of ye air.

/I proceed Now to Consider ye Mechanisme of Sounds\[347]
The foundation of this Essay was layd, after I had discoursed of the spring of the air. Mot. comp. 63.[348] ffor there I asserted that sound was a consequence of the spring, or elasticity of ye air, and wholly dependant upon it; so that take away ye Gravity /~~or Spring~~[349]\ of the air, whereby its Spring is bent and hath force, and let it come to Extream Expansion; all possibility of Sound in it, or to be conveyed by it, is Gone. Just as a string stretched shall yeild a sound, but flaccid, makes No Nois. This may seem Strang to many, who will say, that fishes In water hear, and Sound is heard from ye Exhausted Receiver; &c. as to fishes, they may be sensible of the strokes of sound in ye air falling on ye water, as Moles per=ceiv the treading upon ye Ground at Great distance; but that is Not sound, but touch, as In a wind ye Strongest hous will shake ~~but~~ /yet\ so litle, as Not to be seen, but felt /the blowing up of an hous is felt at great distance\. I doe Not know, that it is prtended Divers un=der water can hear; for I prsume such or=dinarily Stop their Ears, yt ye pressure of deep wated~~r~~ May Not, hurt the organ.

Fishes & divers may be sensible of ye action of sound by Comon touch.

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[347] This line has been inserted later.

[348] I am guessing that this is in 'BL Add MS 32547: Vol. XX. ON MOTION: draughts of writings on the subject, more or less imperfect and disconnected Paper; ff. 430. Early XVIIIth cent. Small Quarto.'.

[349] 'or Spring' has been rubbed out.

276v

72. ~~Sounds~~ /Fanstasmes\

The sound In y^e Exhausted Receiver languefies as y^e Spring is laxed.

Interstitiall air w^ch permeates Glass may have a Spring and propagate sound by forcing y^e Grosser air, w^ch onely can Impress y^e organ.

As to Sounds In the Exhausted Receiver, wee are Informed that as the spring of y^e air is debilitated, so y^e Sounds from thence langue[=?] fie; trans. N^o. 297.[350] It is almost Impossible to find a place wholly void of air, ffor y^e derelicted space in y^e barometer, hath Some air, from Escapes, & what Issues from /among\ the ~~body of y^e~~ Quicksilver, w^ch may rise when ~~y^e spring of [.?]y^e air~~ y^e weight or force of the External air is abated. It is Not Impossible but the subtiler part of y^e air, that per[=?] meates Glass, &c. may as y^e Grosser have Spring, and for y^e Same reason, becaus bo[th?] one & other is under a pressure by Gra[=?] vity. Therefore Sound May be propagate[d?] by that, and when Joyning y^e Gross air move that, but very poorly, as all those Experiment's shew. And I rather thinck somewhat of this kind, is to be allowed, be[=?] caus of these faint sounds that come to our Ear from under water. as upon Explosion's of Gunpowder, that may hap= pen without opening y^e body of y^e water, and Make a very faint sound Just dis- cernable. this may be Conveyed by the Interstitiall matter; but yet Much may be

[350] i.e, *The Philosophical Transactions of the Royal Society* for March, 1705 (Number 297). RN is using the usual citational form used by authors in the *Transactions*. This refers to the submissions of Mr F. Hauksbee on the sound of bells passing through compressed air, *see:* http://rstl.royalsocietypublishing.org/content/24/289-304.toc; also available at http://www.jstor.org/stable/102917

be ascribed to the Stroke of y^e^ Water upon
the air, ffor it is certein the Explosion
lifts y^e^ water, tho It doth Not, as when very
Great, open it. and the water lifted must
Strike y^e^ air. so experiments of beam's, or
hammer's striking under water, are Im=
perfect, becaus the part without may strike
the air. Much accurcy In this sort of know=
ledg May be Gained by variety of Experim^ts^.

The gross air onely affects y^e^ timpane of y^e^ Ear, & when that is Moved by More Subtile, or Inter= Stitiall Matter the Sound Coming from it is very languid.

But However sound, or the action of Sound,
is or May be generated or Conveyed, I am
sure it affect's Not y^e^ Sence of hearing un=
till the body of y^e^ Gross air is affected, by
Exciting y^e^ Spring of it, as I shall explain,
ffor the Drum is a body the air doth Not
permeate, but stopps against. ffor If the
drum were permeable, as a Reticulum[351]
by y^e^ Gross air, as wee p^r^sume it is, by the
Subtiler part w^ch^ pervades Glass, wee Should
Not know Sounds; or they would be so lan=
guid as to be of No use to us. But as the
Drum is Constituted, a Membrane extended,
as y^e^ Name Insinuates, like a drum head,
and a full barr to all passage of air,
and being a spring, as the timpane of
a drum is, Must needs Correspond the
Springy

[351] i.e., 'net'.

springy Impulses of the air, and by velli=
cating ye Nerves subserient to hearing,
Impart a sensation /of a movement\, like that ye air
bring's. Wch Matter belonging to anatomy,
I doe Not Crittiscise upon here, but Confine
my Self to ye Movements of ye air, as they
happen to Create or Modulate Sounds.

It is reasonable to begin with observations of
ffact, Relating to sound, & then discours u=
pon, or apply them.

It is Not Measure but ye Manner of force wch creates sound, but such as come up to a [certein?] degree of celerity, as May Compress ye air

1. It is Not Measure of force, but ye Manner
of it, Impelling the air, wch produceth Sound
ffor a tree or tower falling with an Immens
weight, makes No bruit till it Reacheth ye
Ground. And /yet\ a small stroke upon a bell or
wire strained Shall make a loud & Cont=
nuing sound. And however a small string
stretcht is apt to yeild sound, a Cable, tho
moving with an Immens force, yeilds None.
And scarce any cord made to vibrate, If it
moves distinguishably, hath any sound,
& vibrations Indistinguishable, allwais Sound.
whereby It seem's plain, that a certein de=
gree of celerity, is Required, to produce sound.
Such a motion as Resembles a Stroke upon
a drum, such a stroke must be made

upon

upon y^e^ air, and, by mediation of that, upon
the organ, or no sound is heard. I may Re=
semble an Insonourous motion, to be like a
pressure of a drum head, w^ch^ doth Not Make
it speak, as a smart stroke doth. The Reason
why such a swiftness is Required, will appear
soon;

A current of air seldome creates a sound /but?\ by whis= ling in y^e^ Anfracts of y^e^ Ear.

2. A motion of y^e^ whole body of y^e^ air, such as wind, or any current of it, doth Not af= fect y^e^ Ear, becaus whatever is abroad, In y^e^ tube of y^e^ Ear, there is calme, and It must be some other movement, that sends a force a= long that to y^e^ drum/;besides a Current is Not so Swift\

Sound Is progres= sive, and easily discerned as to y^e^ time of its pas= sage.

3. Nothing More Manifest then that Sound is progressive, and Not by very Swift stepps, ffor y^e^ Eye Shall discerne y^e^ action, & y^e^ Ear not gaine y^e^ Sound In a Considerable time after. and this holds proportion with distance. It is observed that If y^e^ lightning & thunder are Near together, y^e^ danger is neer, but If y^e^ thunder follow long after y^e^ lightning It is farr off; ffor y^e^ Sound Moves slow, but light acts In an Instant.

It moves Nearly as Swift against y^e^ wind as With it

4. It is observed by y^e^ vertuosi del Cimento[352] that sound moves near as swift, against as with y^e^ Wind, Many more observables are of

[352] i.e., members of the Accademia del Cimenti, founded in Florence in 1657. Evidently RN had had the opportunity to study a copy of the *Saggi* (*Saggi di naturali esperienze fatte nell'Academia del Cimento sotto la protezione del Serenissimo Principe Leopoldo di Toscan e descritte dal segretario di essa Accademia* [Essays on natural experiments made at the Cimento Academy under the protection of the Serene Prince Leopold of Tuscany, and described by the secretary of that academy, {i.e., Lorenzo Magalotti}], Florence, 1666). It may have been a copy brought to England by his brother Dudley who had sojourned in Florence, and developed many contacts on Italy. The *Saggi* was the accepted guide to experimental/laboratory practise during the century that followed its publication, it offered a model of practice admired and followed by members of the Royal Society. No official links were ever developed between the Accademia and the Royal Society. By the 1680s the Accademia del Cimenti had ceased to function. A 1691 edition of the *Saggi* can be accessed at http://echo.mpiwg-berlin.mpg.de/ECHOdocuView?url=/permanent/einstein_exhibition/sources/5UY9ENA9/index.meta&pn=9

of Sounds In generall, but I deferr them to
avoid Repetition, for after I have proposed
my solution, I must reiterate, to Shew y^e^
caus of them. therefore I proceed to Resolve
y^e^ Caus of sound In generall.

The air hath a certein & Stated power of Spring w^ch^ is worked u= pon by body's moving swifter thro it, then y^e^ density of y^e^ air permitts to pass without Com= pressure, or then y^e^ air can Quietly give way.

The air hath a certein density, and also
a spring of a Stated force In y^e^ place where
y^e^ Notice of it is taken. Density, with Respect
to other fluids, as water, oyle, & y^e^ like w^ch^
are less rare, and active, and also to Ether
or a purer part of air, w^ch^ wee May Sup=
pose to be more active, or rare; And the Sprin[g?]
with Respect to higher & lower In the air=
sphear, In y^e^ it is more or less /powerfully\ Elastick, ac=
cording to this measure however it happen's
y^e^ air hath power to Resist Compression, &
being comprest to dilate againe. A stroke cannot be
made upon y^e^ body of y^e^ air otherwise then
as bodys are made to pass thro it swifter
then may be, according to y^e^ density &
Spring without Some ~~fracture~~ Compression
or fracture, & perhaps both. Wee May see
somewhat of this In water, In w^ch^ If a body
move slow, the fluid accomodates y^e^ passage
by giving way before & closing behind as

hath

hath bin shewed. but this is while the
celerity of y^e^ movement doth Not exceed
a due measure with Regard to y^e^ density
of y^e^ fluid. ffor If the motion be Rapid, it
is well knowne what work it makes in y^e^
water. ~~But air~~ The same happen's In y^e^
air w^ch^ is of much less density, or obstructive
to motion, therefore It bears motion in it
with Greater celerity; And wee know, by
the passsage wee make thro y^e^ air, that al=
tho It be Much Swifter then any ordina=
ry body can well pass In water, yet it
Makes no great disturbance In y^e^ air. yet
This hath its Measure, & proportion, as when
it Exceeds, (observable Enough In the passage
of a canon-bullet w^ch^ is swifter then the
fluid according to its [Tone?] can comply with,)
~~ffor~~, y^e^ Sound discover's what a Rending it
makes.

Swiftness In y^e^
air often Not
onely Compresseth
but so Much as
makes a Torri=
cellian void

Wee must then consider that air, being
Compressible, as well as dilatable, If a vio=
lent motion be in it, w^ch^ the tone of its
composition doth Not accomodate, It runs
up in heaps before, and dilates behind,
And If the swiftness be very great, it shall
leav a torricellian vois, becaus the air

[353] On this page and the next RN has overwritten the numbers 77 and 78 with a 4, making them 47 and 48.

478. Fantasmes,

doth Not close so fast, or Soon, as Is Re=
quired. And for this reason, Not onely the den=
sity of ye air, is an Impediment to Rapid
Motion's In it, but ye weight of the air-Sphea[r?]
or its Spring; ffor that bears upon all force,
that tends to make a void, so that every
Compressure of ye air, is /In tanto\ opposed by ye force of
its Spring, much More when ye Motion is
so sudden to make a Rent in ye body of
ye air, and thereby a vacuity, as it is called.
And much of this violence to ye air depends
on ye forme of the body's Moving in it, ffor
flatts Strain it, more then oblong's, being
so directed, as easy Experience shews; and
a Sphear tear's it enough, when It hath
a perseverance by mean's of much substa[nce?]
wch is ye case of a Canon ball, wch put In
Motion by ye ordinance, maintains its
cours, by ye power of its weight. If wee Ima=
gin a body at rest In ye air, and some
power gives it a start with ye speed of
a Canon bullet, whereby a rent or void
is made in ye air by ye Suddenness of ye
motion, here will be two Strokes upon
the air. one of the first start of the body
and another of the~~ir~~[354] air closing again

When such void is Made, there is a double Com= pressure. 1. from the strok, & 2 from ye Closure.

so

[354] 'ir' washed out.

So that, If these strokes be y^e^ Caus of
Sound /(of w^ch^ anon)\ It shall be redoubled, and that is
found to be the case of a Canon or Musket
discharged /ffor\ there is allwais a first, & second
sound following at y^e^ heels of it. A pheno=
menon not hitherto /observed & so Not\ Resolved; Nor will
Recours to Ecco doe it, ffor the strokes are
neere together then any Ecco can Make
And Ecco's are Not y^e^ Same in all places,
but that duplication of sound seldom or
never fails. It is Most sensible, upon y^e^
Explosion of Gunns; ffor when y^e^ barrell
is filled with y^e^ accension, all air is forced
away, and the Extinction of y^e^ fire leavs
the barrell /and Some Space without\ as a torricellian
void; Into
w^ch^ y^e^ air Rushing, with all its force, is sud=
denly Stopt, but y^e^ vis of y^e^ crowding in
is Not so cohibited all at once, but goes
on, so as to Make a great Compression
of air In y^e^ barrell, and that starting forth
causeth so Great a Sound. this aggrees
with thte fact, for the first sound Made
by y^e^ protrusion of y^e^ ball, is the least, and
that of closing y^e^ air In y^e^ barrell last
and Most violent. The solution of this case
fell so aptly here, I Could Not decline it.

but

Double strokes
found on Explo=
Sion's of Gunns.
& y^e^ greatness of
y^e^ Sound depends
on y^e^ latter.

80. Fantasmes

A compressure on ye air runs on Every way com= pressing & dila= ting In ye air to Infinite, as ye un= dulations of water. & so enters ye Ear.

But Now I come to the buissnes of Shewing how this action of sound moves. I prsume such a force upon the air, as makes a compressure, whither there be so Much of force to caus a vacuity or Not. Then a com= pressure In any part of the air, hath a force to dilate, wch In ~~act~~ /consequence\, makes a compre[s=?] sure on the next air to it, and that on the next & so Quousq.[355] And It Must happen that this dilatation Shall proceed Every way [~~...~~?] In an orb, and Not as a thing projected In a strait line onely from the force; It is obvious yt ye air Comprest shall spring forth every way as it finds room; ffor the principle of that Mo[=?] tion is an ~~Intrinct~~ Intrinsick force, wch depends Not, tho consequent ~~upon~~ upon ye Stroke. this passage of a Compressure of the air, In orbe coming thro ye tube of ye Ear to ye drum, is that force, or Stroke, yt Imprints In us the Idea of sound, whereof a Nicer disquisi= tion will be Made anon, but ffirst it is rea[=?] sonable, to Render ye Notion as Explicite as may be.

Re/se\mblances to found out, Gross to ye Sencs whereby the Image of this action may be Impres't.

In the Comunicating thoughts of this Na= ture, however clear to orSelves, wee Can= not render them so to others, not beaten In a cours of such thincking without some gross or

[355] i.e. '*quo usque*' (Latin), meaning 'however far'.

Fantasmes ~~42~~ ~~81~~.

Gross or Sensible Images Refferred too, w^ch^
by analogy, or manifest Resemblance
may palpably desribe them. And according=
ly ffor this progress of sound, I Shall produce
2. Resemblances, one of a long Cord
and y^e^ other, more naturall & exquisite,
y^e^ Circling of waves from a stroke upon
water.

A cord Strained from y^e^ Earth up aloft, If struck hath a Spring y^t^ works as y^e^ Spring of y^e^ air, sensible to feeling.

1. The Experiment of the Cord is this.[356] At y^e^
structure of St pauls church, A stay from y^e^
Engin-sheers upon one of y^e^ west towers
was made fast to a Great stone neer the
Entrance Gate. the Cord was larg as a Com=
mon ship Hauser, and strained Enough by
its weight, w^ch^ made it Mount Courber,[357] as
ropes ordinarily hang. I stood at y^e^ end of
y^e^ Cord below, and Smote hard upon it with
my cane. And I could perceive the flexure of
y^e^ Cord made by y^e^ Stroke, tho Not considera=
ble, apparently Mount up to y^e^ Sheers a=
loft, & there Reflect, & Returne, and Reflec=
ting at y^e^ bottom, mount up againe, conti=
nually. Inlarging y^e^ arch, tho growing less
perceptible, till I could See No More of it,
w^ch^ might be after about 6. Returnes. then
I Smote agiane, and for better oberving
lay'd

[356] see also BM Add MS 32546, f. 316v.

[357] i.e., 'curved' (from French).

The motion May be felt after lost to view.

/layd\ Hold upon ye cord Neer the Stone, & then I could as well feel, as see, ye wave run up and downe; but, that wch was very surpri= Sing, ~~was~~ I could feell the Returnes very often after I had lost all Manner of sight of them; and with great admiration of the Nice sence of touch, I Could perceiv Many More Returnes by meer feeling, then I Could see, and It was hard to Say, when all per= ception of them was quite wasted. The Cours as I Judged was, the flexure or Wave at Every Returne grew larger, or to take a Greater portion of ye Rope, till at length it became bisected, and then both devisions run into one, whereat all Influence of ye Stroke /as to my Sence [w?]\ became lost In ye Greater Sway's of ye
Cord from wind, & ~~actiden~~ accident's that disturbed it. Here is Manifest ye property of a spring; ffor when ye Cord was bent with ye stroke, the force of recovery bent the part next to it, that is made it give way. and so the next. &c. And this must run up the Rope, becaus the stone to wch it was fastned hindered the force spending that way. but If I could have struck ye Cord In the midle the force had Spent both way's up & downe and cros't each other Reflecting Continually.

Wee

Example of a wire worme, of w^ch a Compressure carry's it self thro, as compres= sion of y^e wire Spring.

wee May consider this action In another manner, Suppose the Cord were a wire= worme, and Gravity ~~Extro~~ abstracted (Men= tally) so as wee may suppose it to Run Horizontally a Great ~~strete~~ length, as for Instance a Mile, & so fastned at both Ends. then lett some sudden force Compress a yard or two close home to one End, & then desist, whereby y^e spring working a dilation may have Effect. It will Not be doubdted that this compressure will, as a wave, run on to y^e further End, and there the compres= Sure stop & for like reason be Reflected back and so toties quoties.[358] for the worme can= not Spring out, without driving the next & so on. And If Instead of the End, the Com= pressure were made In y^e Midle It would o= perate in like manner both ways. this Image hath a neer Relation to the passage of a wave in y^e air, y^t causeth Sound, as wee Shall Shew Coming to Collate them.

like shewed by y^e undulations of water.

2. The other Image, is that of water cir= cling from a stroke. This is an object so comon, as Not to be tituled an Experiment, And there needs onely to observe from it as a thing knowne. The reason of such circling is

[358] i.e., 'as often as', or 'repeatedly', from Latin.

is the same, [to?] this porpose, as of a Spring /bent\

The force of Gra= vity Works as a Spring. vis^{t}. con= tinuall pressure In a certein di= rection.

ffor a spring is No other then a force that move's a body in Some certein direction, and works Continually, so that when obstacles are Removed the effect appear's, according to the strength of the spring, and y^{e} yeilding of ob= stacles. And upon water this office is done by Gravity, ffor If any water be raised above y^{e} levell, it perpetually tends downe wards, so If a valey be made, there is alwais a like tendency to ffill it. and as the perfect free= dome of a Spring, is the terme or ceasing of its force, so is y^{e} levell to water, or the per=

so water, pendu= lum's, & springs move & Rest by analogous caus.

pendicular to a pendulum, w^{ch} hath the very same Consideration's. ffor there ceaseth y^{e} effect. ~~therefore that w^{eh}~~ and When any of these are put by this terme of y^{e} force, where[=?] by it comes to act, and then is set free, there is an Impetus acquired, w^{ch} In y^{e} terme of rest continues, and having No opposition, carry's y^{e} body from its terme or place of Rest Into an opposite force Increasing against it. and so is Reduced againe, & makes fre= quent Returnes, or Swing's, they Call oscillations or vibration's, ever deminishing and coming gradually to perfect Rest, as seems to us.
I discours of this In generall termes, becaus it is Not an action peculiar to spring's or pen[=?] dulum's, but to Every thing, w^{ch} is Ever

under a force directing one way to Some
period; and Such is y^e^ Surface of water. So
all that is comonly observed of pendulums
holds true of spring's and Watery undula=
tion's, ~~&~~ particularly that of S~~yn~~/Iso\chronisme.
I doe Not allow any exactly /to be\ so, ffor when
y^e^ force bear's hard, as when a pendulum
is drawne a-side to above 45. degrees, It
Shall Make Quicker Returnes then when
but Just Moved from the perpendicular.
so perhaps water If Much disturbed shall
have undulations, a litle swifter then
when Near setling. The like is found by
Musicall strings, when struck too hard.
ffor y^e^ Sound will sharpen, (and a true tone
is y^e^ best proof of ~~syn~~/Iso-\chronisme). And as y^e^
Monochord made to vibrate In Many
devision's, shall all become aliquot parts
of y^e^ String, and so work /sound In unison Each\ in
ballance /ag^t^ y^e^ others\ and
alternatively; So If y^e^ Surface of water
be Much disturbed, ~~so~~ as to fall Into a Con=
fused Ripple, It May be observed those /Ripples\ are
Isocronous, and alternately by rising & falling
correspond Each other. All this I have but
touched here, and Intended onely to Shew
that however wee charg th reason of
sound wholly upon the spring of the air

[s?]o watery Mo=
[v?]emen^ts^ Not Inept
[f?]or demonstration
[o?]f Sound.

wee

86. Fantasmes

wee are Not out of the way, Endeavouring
to demonstrate its Effect's, by y^e^ Undulations
of a watery surface, tho water it self hath
No Spring. So wee proceed to observe.

The circulating undulation's made by Returnes of water put out of level, & with an Imprest [form?] passing beyond it.

That when y^e^ Calme Surface of water is
touched whereby any part is raised or de=
pressed, that w^ch^ is raised, is driven from the
touch, and In falling must caus other water
to rise, as also it self fall lower then the
levell; thus the wave or two w^ch^ this action
necessarily makes, hath a progression in Cir=
cle Every way Indifferently from y^e^ first touch.
And as the process continues y^e^ circles Inlarg
and Consequently the movement is less
swift, as y^e^ diameters squared; ~~that is In pro=~~
~~portion subduplicate /or neer it\. so as, If the motion~~
~~Inlarg the diameter. 1. yard, In a second~~
~~of time, In 2. seconds, It will Inlarg /neerly\. 1 1/2~~
~~yard.~~
~~& so on~~ /In proportion Reverst\ to Infinity of subdevision,
being
Ever somewhat, however Not perceivable.
And also the waves, as the force /by spreading\ slakens
Shall grow broader & mount less, & this
process runs to Infinite also. And If there be
any anfractuous places, or channells strait
or crooked, about y^e^ sides conteining this
water, w^ch^ a current would pass by, this
undulatory ~~way~~ wave shall Enter & search
every

q^u^.[359]

The Extent of these Spreading is to Infinite.

They penetrate all channells & nooks. w^ch^ current's doe Not enter.

[359] '*q^u^*' here, as elewhere in this essay, is written in the same ink as the main text and does not appear to be a later addition.

every Corner, & No Crooks or Returnes Shall
stop it, and by mean's of different chanells
the ~~way~~ wave may thro severall way's
arrive at one place, and seem as from
2. Causes, tho truely but from one stroke.

They pass each other without confusion.

And If there be divers of these undulations
made by severall strokes on y^e^ Surface, they
Shall all, however Numerous, pass Each o=
ther, and goe on distinctly againe, and be
not in y^e^ least disordered. w^ch^ phenomenon
is strang enough, but Resolved by that ge=
nerall observation of simple movements,
that the same body, would Retein y^e^ Influence
of Infinite direction's; and the Complex,
is compound of y^e^ simples, And sheweth to
us In a Complex Idea /by way of symptoms\ what cannot be
clearly understood, but In a simple Instance.

They Reflect according to y^e^ Rule of simple Reflection's.

Then when a [~~....~~?] wave circles thus out
and meet's obstacles, or arives at y^e^ /sides as\ limits
of y^e^ fluid, then it Reflect's and sends back
the wave againe; ffor the side or obstacle
doth but alter the direction of y^e^ process,
for that w^ch^ cannot rise ag^t^ the obstacle
tumbles back, & becomes a beginning of
a Revers't Cours. And In this action, the rule
of ~~Refleq~~ Reflection In Equality of angles
is exactly observed. And so the waves made

& Re-

88. Fantasmes

& Reflected shall Reduce yᵉ Surface of yᵉ Water
Ripple of water seem's confused Not as being so, but for want of our facultys to discerne yᵉ Se= verall Courses It is made up of.
to a seeming confusion, or Ripple. but In truth Every Cours is conserved thro that seeming casuall dancing of yᵉ water, and would ap= pear so If wee had faculty's to Instruct us. as for Instance, If yᵉ waves of one stroke were red, of another blew, & so Red, Green. &c. wee Might discerne much of this for a time; but Even that would subdevide & mix be= /-y\ond our capacity to distinguish. And this I may call a Murmur of yᵉ water, or sound Confused, & Indistinguishable. And lastly

In a tube pas= seth with less de= minution then open; becaus it cannot dilate, by orbs.
If yᵉ wave takes Into a tube, it passeth with less deminution of force, then open on the water, ffor ~~there~~ /when free\ it Inlarges by circles Every way. but In a tube It run's strait forewar[d?] & looseth litle. And so Neer a wall yᵗ hinder[s?] yᵉ Spreading of yᵉ wave one way, It shall shoot forewards, More then Elswhere ~~that~~ /becaus\

*q*ᵘ
it Can ~~/not\~~[360] spread, wᶜʰ answers our Whisperin[g?] devices, as will be shewed. Then If it should

If yᵉ density of yᵉ fluid is more, yᵉ Circling's are swifter as of Mer= Cury. but yᵉ Spissi= tude or tenacity makes them Slower as fast hony. &c.
So happen that yᵉ fluid grew ~~thinner or~~ /less viscous\ ~~lighter~~ Gradually, as from Mercury /tarr Hony or thick oyle \ to Wa[ter?] the wane would shoot out that way. for where the fluid gives way easyer yᵉ wave will accelerate that way. these are the cheif observables of watery undulatio[n?] It Remsines to apply somewhat to them.

[360] The word 'not' has been inserted and then washed out.

285r

Imagin wee have bin talking of sound & y^e^ Case is y^e^ Same.

Fantasmes. ~~46~~ ~~89~~

The motion of air Compared with y^t^ of water for celerity.

1. The progression of Sound, as was observed is Most Notorious, and the celerity bear's some correspondence with y^e^ rarity of air Compared with water; the Nice may prove y^e^ Exactness, & how neer it Comes, If air be to Water as 20. to. 1. then /It may be sayd\ If a wave Moves a yard in a 2^d^. sound moves. 20. but I con=ceiv y^e^ Sound hath yet a quicker passage then that. ffor the rarity being 20. to 1. in dou=ble space, Quadruples, w^ch^ will create a pro=gression swift Enough. And the spring of y^e^ air being according to y^e^ Incumbent weight of y^e^ Superior air, may act with more force then y^e^ bare weight of y^e^ water a litle lifted.

caus why Sound to windward is Neer as Swift as to leeWards. & y^e^ case as to Watry undulations & ~~water~~ sound by y^e^ air distinguisht

2. That sound run's to windward, neer as swift as downe y^e^ wind, hath its like In y^e^ water. ffor the wind answers to a current of the water. And lett that be Never so Swift the undulations Shall be In perfect Circle for to say truth, the Current of the whole to y^e^ undulations on y^e^ Surface, is as No Motion /at all\, And In a temperate river one may see y^e^ Circles goe downe stream, Even as wood, & straws upon /it\ ~~y^e^ Surface~~. And therefore the circles arrive at y^e^ parts of y^e^ Shoar downe stream, sooner then at those above. but the reason that this is

not

is Not perceivable In sounds, is that the Current of a wind, is so very slow, with Res= pect to the Quick motion of ye Sound, that practicall Scrutiny will scarce find it. And It is an error to thinck yt Either ye undu= lation's In water, or the dilatation of sound, In a current of ye water, or air, be= comes wall; for ye fluid before goes away as fast as that behind follows, so as to ye dilatation, It is as /a\ meer Stagnum.

The force of ye caus doth Not add swiftness to Sound, but a litle onely, at first, /(if very furious)\ it Comes at length to the measure ~~of~~ yt ye ordinary spring gives it.

3. The violence of ye stroke, doth Not add speed to sound, or, as I Shall call it, the Comprest-wave that Causeth it. but that passeth according as the strength of the spring, and laxity or rarity of ye fluid Re= quire. whereby the sound of a Musket is heard as soon as that of a canon. but yet neer ye force, as wee find in all vibratory mo= vemements, If the begginning be with violence It shall pass somewhat Quicker, then after it is composed upon ye meer force of ye Spring that is when ye Extraordinary force of ye Stroke is spent. but If ye medium grow more rare, then as was sayd the motion accelerates. where= fore neer the earth many things Influence the regularity of the passage of sound. as If an ordinance is discharged upon ye Sea

motion of Sound accelerates With rarefaction.

the

the dilatation can be but In an he=
misphear, therefore it creeps faster, and
passeth farther then It doth higher. but
then it is to be Considered, that, y^e^ air up=
wards grows thinner, and less prest; so perhaps
faster neer the perpendicular, then lower
and so forme an oval, rather then a Circle.
And thence wee May Imagin, that one Who
a voice is heard upwards sooner then downewards
calls from below is sooner heard, then one y^t^
is aloft and calls downewards. when sound is
among Inequality's, as mountaines, valley's,
Ruins, Grotto's, It is plain from y^e^ Eccos that a
Ecco's are Reflec=
tion's, w^ch^ as y^e^ Cord have Many Iterations.
comprest wave is Reflected, and It shall, by
Redoubling y^e^ Returnes, appear to come &
Goe, More then once, as was shewed of the long
cord. And some have bin so Curious, as by
shaping ceiling's /sounds sent\ from a focall point, ~~eccoes sounds~~ have eccoed strangely distinct & very
loud & often; & so prove that the Refections
of sound are, In y^e^ Main, as of light, or More
Simple movements under equality of
Angles; and y^e^ Same is manifest to y^e^ Eye
upon water. Many ~~of these~~ Experiment's
of sound, may be found In Kircher's ars
magna Consoni Et dissoni, and In the Esper=
rienze del cimento.[361]

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[361] Athanasius Kircher, SJ (1601-80) was a German scholar and polymath living in Rome. He wrote on topics as diverse as geology, the intepretation of Egyptian hieroglyphs, China, medicine and mechanical and technological invention. The *Musurgia universalis sive ars magna consoni et dissoni in X. libros digesta*, an encyclopaedia of music in ten books, was published in Rome in two volumes in 1650. It can be viewed on the web at http://echo.mpiwg-berlin.mpg.de/ECHOdocuView?mode=imagepath&url=/permanent/library/B398U3SN/pageimg. For the *Esperienze del cimento*, *see* note, f. 278r, above.

92. Fantasmes.

It may be diffi= cult to distinguish whence Sound Comes, becauS by parting at obstacles It ar= rives by divers courses.

4. As to the art of Augmenting Sounds, It be[=?] longs to another place, I mean an Essay I Intend on y^e^ art of musick, so there I Shall Endeavour to Shew y^e^ Meaning of Instruments Such as trumpets, monochords, organs, vialls & y^e^ like, therefore supersede it here. And onely take notice that If obstacles are in y^e^ way of y^e^ Comprest wave, it lapps round them, and so proceeds; w^ch^ accidents some= times makes it difficult to know from when[ce?] y^e^ Sound Comes. I have bin sensible of a double sound from one stroke; as sitting by a chimny, one Nois hath Come in at y^e^ door, & y^e^ other downe y^e^ chimny, and yet Mani= festly from y^e^ Same stroke. but directly It is easy to perceiv whence y^e^ Sound is; ffor If an Arch of a circle is given, y^e^ center may be fou[nd?] And It is a different Case to y^e^ Sence, when y^e^ wave Enters y^e^ Ear square or obliq. It is us[e?] y^t^ hath taught us, as In comon feeling, to distinguish so Nicely; ffor If there are divers differences or modes In y^e^ action y^t^ causeth sensation, the sensation's will be also diffe[=?] rent, and Experience as I sayd tells us w^ch^ is w^ch^. It is therefore comon, when a sound En[=?] ters obliq, ffor y^e^ Sence to perceiv it, and ffor better Judgm'^t^ thereon y^e^ creature will turne his ear

The sence In ye Judgmt of sounds by distinction of them, is Exqui= site to a Wonder.

ffor force, ye capa= city of ye organ is ye limits of Sound.

sounds drowne one & other, for ye lesser unless of a very different kind are not perceived wth ye Greater, but of a very different kind a much less will be perceived.

the Ear to it so as ye Sound May Enter wth Greatest advantage, that is square. As to ye Capacity of sence, with Regard to sounds wee Must consider, that originally sence is Infi= nitely Nice, and No Nois can be So small, but It may be perceived; but practically ye Sence is limited, by the tenderness of ye organ, & the Comon sounds that are about us. as to the latter, If a greater sound hath ye attention ye effect of the lesser fails, as stronger sensations drowne ye ~~lesser~~ /weaker\. therefore when ye air is full of Noises as at Midday, wee doe Not hear any thing from farr off. but In ye night, ye time of silence & cessation of Noises, one May hear very slight sounds, and Such as Come from very great distance. here wee are limited one way, ye other is, when ye force of sound is so Strong that it Shall wound ye organ, or at least paine ye hearer. Such is ye Sound of bells & or= donance neer hand, wch make some for Ever deaf, other Confinemt then these Nature In ye Sence of hearing knows Not; It is Not Im= possible, but If there were None of ye /comon\ Sounds abroad wee ordinarily hear, nor any other more Considerable then what I am about to mention, wee might hear ye hissing of cometts, & perhaps the fragor of ye fire, of wch ye Sun's body is Composed. but then wee must

94. Fantasmes.

no sound can Come from without the air Sphear, for fault of Spring

suppose such a Springy Medium as the air is; of wch I very much doubdt, but rather thinck, beyond ye air sphear there is No Spring, and then there is No Conduct of Sound, wch depends wholly upon ye Compressure of an a= eriall fluid. But to conclude this paragraph observe here a plaine declaration how ye Ear may from ye Mode of a sound, distinguish from what region it Cometh. let A. be ye Ear. K.

<diagram>

ye tube. E.f. a Comprest wave, on the center D. Rad. D.A. and G.H. a com= prest wave on ye Center C. Rad. C.A. the manner of the one & other Entring ye tube is very different, and so as may

A demonstration how ye cours of sounds affect ye Ear, so as to dis= tinguish whence they Come.

be perceived. the former Comes obliq. & the latter almost direct. Where Note a litl turne of ye Ear by raising ye tube /K.\ towards. A. makes that wch was obliq to become direct. And thus what with ye Manner of Entrance, and the strength of ye Sound, Joyned with some acquain[=?] tance with /ye mode of\ it. a man shall perceiv Whither it is before or behind or In any Quarter. So ye Com[=?] mon feeling, wch is but putting ye hand where it is resisted, the various modes of Resistance, as there is from wood, Mettall, cloth, Earth &c, are So different that with a litle acquaintance ye Sence distinguisheth the one from ye other.

5

Observation of numerous Sounds passing thro ye same medium ye Similar Not distinguishable as Hum & Murmur. but the dissimilar as whistle, & ye like from singularity distinguishable.

5. the last and most Considerabe Remarq I Shall make of sound, is that wonderfull but Notorious property In ye air; an hanfull of wch filling a Narrow passage, Shall transmitt miria[d?] of diver's sounds, that is ye Comprest waves yt caus them, thro & thro, backwards & forewards without any disorder or Confusion at all; when noises are similar & frequent, such as the Mur mur of a croud, wee have not a capacity so nice and Nimble to persue Each, but all toge= ther make a blended Sound wee Call an Hum, yet Of one Calls aloud, cry's, or whistles, It is Instantly from ye Singularity perceived. This Strang preceeding of Sound is exactly demon= strated by ye waves undulating on a Watery surface, wch may come to a Ripple, and So be unaccountable, but yet Regulated un= der Each Efficient caus, tho Not perceived.

The same para= lelled upon water

And If any accidentall stroke falls on ye same surface, It shall rais a conspicuous wave, wch shall walk over all ye Ripple; and so is ye Sound. Here of an Invisible action, tho of all other's most sensible in another way, I have exposed divers types or Images, taken from Experience of analogous movements wch doe as it were unfold all ye process of it to ye eye. And If wee observe the action

is

96. Fantasmes.

The action y^t bring's sound, is Exposed in all y^e 3. dimensions of Space In the proceeding.

is adumbrated In all. 3. demension's. the first of a cord, is of a spring, w^{ch} operates in /line\ longitude, that of y^e water, In /plain or\ latitude, and this of sound, In /sphear or\ profundity. so that what= Ever is ffound in one, must be allowed In the Rest, with due computation. as the first by addition, the second, by Multiplication or Quadrature, the third by a second Mul= tiplication, or Cubifaction.

Every Man Must forme Images of these conditions of Motion, & sence consequent of them, as best they may wee doe but assist.

Now after all I can say, Each ones Reflec= tio's, and Comparison of things In his owne observation, if accustomed so to Reflect, will fur[=?] nish more Eclariscissement In this subject then I can Esteem to be had from My descriptions. I trace thing's, as neer as I can, and by the Most lively and p^rpared Images I can make, but Eac[h?] hath his owne way, and one Cannot take from another, who will often gather by himself. An[d?] This Infinitely various proceeding of divers Com[=?] ~~plex~~=prest waves, or sounds In one & y^e Same Me[=?] dium, directed all Manner of way's, and at y^e same time, as many or more various Cros= =Sing's of the action of light thro y^e Same Me= dium, make it necessary, & shew I had reason to say that, light was ~~as~~ y^e Motion of y^e Whole medium, and sound an action progressive thro it, Instancing In a Stroke upon a body of water, whence in double action

was

was Consequent, one Repʳsenting that of light
and yᵉ other of sound. And the Contriving of
distinct Essences to serve yᵉ turne of these, of
light at least, was to suppose ridle rather then
argue probability. ffor In Short Such Must be [as?]
body & No body, act and make sensible as,
touch of body, and yet permeate body and
it self; such chimeras will /often\ rise and fill the
vacant Spaces In our understandings. /, when=
our poor Mean's of observing ~~will~~ /doe\ Not provide
tp supply them.\[362]

[362] From 'when our poor Mean's' has been added later, in the same ink as the marginalia.

98. Fantasmes.

The subject of fire is to late here, but better late then Not at all.

I shall now address my Self to ye Subject of fore, & its symptoms, wch, to say truth should have Gone first; ffor as it is knowne by us from an Idea not In the thing, but In the Imagination(. ffor what Els is, pain, heat, cold, &c?) I Rank it under this Generall; And for primacy, other matters already discoursed, depend much upon this. ffor wch rea= son it claimes it; but ye hurry of utterance let ye others escape, and Now this, If Not ill done, will not be out of time.

Divers opinions of fire, and ye vul= gar carry's it, but philosofers, put them in some learned atire.

The vulgar opionion of ffire hath allwais bin, that there is some essence peculiarly belong to it, and philosofer's, ~~who~~, for ye most part, have ye Same opinion's with ye vulgar, /but\ are pleased with Investing them in some exotick termes, to make them look as learned /I say\, In this particular of /ye\ fire, Call it Element; and suppose it to be one of four prime essences of wch all thing's upon Earth are Compound. Since Cartesius, there hath bin a disposition to thinck ffire to be onely ye Rapid Motion of Minute matter; and the chi= mists, and of them ye most worthy Mr Boyle hath demonstrated away, ye fancy of the. 4. Elements, and fire with ye Rest, concluding yt It is no other but motion of Corpuscles.[363] But yet it sticks In our Minds that ffire is some= tho Wee know Not what, more then Meer body in

The Elements Ex= ploded.

[363] *See* RN's description of the fire at the Inner Temple in his 'Notes of Me' (*Notes of Me: The Autobiography of Roger North,* ed. Millard, P. T., University of Toronto Press, Toronto, 2000, pp 110ff).

The action of fire without raising a new Spirit or Essence to Resolve it, by Meer Motion construes all y^e^ vugar Expressions y^t^ belong to it.

In motion; the reason of w^ch^ prejudice is that wee ascribe to the thing, y^e^ creatures of our Imagination, ffor abstract our Idea's, and there is No reason in y^e^ world, to strain for a New essence, to ans^r^ all y^e^ positive effects of it. Fire, wee say, consumes, It warmes, and it gives us shrew'd pain, when any part of us is burnt. that is to say, when a coagu= lum of apt matter, is In y^e^ Midst of other loos stuff, w^ch^ is much agitated, these parts Insinuate Into y^e^ lump, and devide y^e^ parts one from another, w^ch^ being scattered out of our Sight, wee say it is Consumed. And the tone of our flesh & humours, depending on a moderate agitation of the matter of or In them; when that is wanted, wee Call it Cold, meaning a privation of a fitt degree of fire, and that applyed, then wee say it warmes us, that is takes away y^e^ pain or bring's a pleasure, of such sort as wee call Cold, and warm. but then, If it be to a degree So Much greater, that the substance of our flesh begin's to devide and Conforme to such motion; wee are sufficiently affected, & Cry out with No litle Exclamation. these are Strong Ideas, that grow from y^e^ Constitution of our flesh, & Not from fire, tho that Causeth

such

Error by Conferring our Ideas on y^e^ action of fire.

Fire cannot be Represented but by types, for No discovery will ex= pose the distinct action. but by types, It may be Rendered as possi= ble & Probable to be Meer Motion.

Knowledg Enough Not to be deceived by opinion, as knowing, when it is Nothing so.

such Ideas, In like manner as hath bin dis= courst on other occasion's. But yet say they wee cannot Conceiv how such wonderfull Effects can happen from meer movement of Minute matter; This is that w^ch^ wee are to Encounter, and If wee can, make it seem probable that fire hath No peculiar Essence, or other Ingredient then as abov[e?] by Rep^r^senting the modes and operation of it, by /such types or\ Images as may be Comprehende[d?] and are y^e^ Same or analogous with it; ffo[r?] the thing cannot be knowne distinctly of it self, being buryed In minuteness, and of all Motion's, ~~It is~~ y^e^ Most Complex, and abstruse. And the great failing In philosofy is when thing's are difficult to Reconcile, wee must, It seems, come to some Resolution and Either Not applying to thing's as wee May conceive them, or missing our aim In it, wee proceed to meer Invention, rathe[r?] then be at all suspended In opinion, as If the, ne sçay,[364] In a philosofer were a fault unpardonable, and an Eternall disgrace whereas In truth, It is the best office of a searcher of nature, to distinguish the things understood, from those that are Not so, and not onely In Gross, but thro all degrees of knowledg, from certeinty, thro [propability?], & so to meer possibility. some

are

[364] i.e., 'je ne sais pas', i.e., 'I don't know'.

knowledg, y^{t} is Judg= ment of probabi= lity, & possibility is different, from y^{t} absolutely Cer= tein w^{ch} is onely in y^{e} Mathematicks And is Not to be layd aside becaus not y^{e} Same.

Some are onely for the certeinty, and I blame them not, and they doe great ser= vice In Cultivating their Soyle, w^{ch} is Whol= ly Mathematicall. but If they Expect all Should stand at their post, & goe No far= ther, as If No knowledg lay beyond it, I leav them. ffor Question's of probability & possibility, Even In aggregate or Complex cases, Exercise the Judgm'^{t}, and More Exqui= Sitely then casting accounts. And I must Say that I esteem a Rationall opinion such as will bear y^{e} test of all my scrutiny, and after all, In Spight of aversion, con=

A Nobler Judgm'^{t} of y^{e} former, as more dilated, & Nice then of y^{e} latter, w^{ch} is in rule & certeinty If they Can hitt it

straines Me over to it; More then all the Geometrick ~~problem's~~ /propositions\ sumed up together. And one, as Copernicus, whose Judgment Gat the better of his senses, ag^{t} the Evidence of w^{ch} he argued, and Concluded y^{e} Grand truth of y^{e} planetary systeme; did More then all the Geometry In y^{e} world Could Ever have Compassed; but away with digressions, and let's to y^{e} matter.

The being and Continuance of fire depends Wholly upon pressing & being comprest by or In some Medium.

The being and Continuance of fire, depends wholly upon Compressure; the sun is Compresst by y^{e} circumambient matter, detruded upon it by Gravity, the like wee Imagin of the fixt starrs; and the ordinary fires amongst us have

have the pressure and Spring of ye air bearing
with full force upon them. And If this pressure
be taken off, as is done, In great Measure, in
ye Receiver, by ye air pump, the fire goes out[,?]
And If an almighty power should disable
the pressure of the matter about the sun
even that would Extinguish. ffor fire being,
as our position is, onely a Rapid Motion of
minute matter, If there were free scope a=
bout it, then by ye laws of meer Mechanism[e?]
It must dissipate or dispers, and So loos ye
forme of fire. therefore where is fire there is
a compression, as is Sufficient to hold the
combustion together.

when pressure is Removed from fire as In ye Receiver it Strait goes out.

Here you have one cheif article of My
Notion of fire, but it is a Mistery without
the Next, And that is, where ever /light\ fire is,
there is a Torricellian vacuity. by wch va[=?]
cuity I mean a totall Exclusion of ye
Compressing fluid, and onely the Combus=
ted matter Included. To Instance In a
Comon fire, /such as\ a Candle. I say, there is No air
within ye Compass of ye flame; but the force
of the agitation of the Ignited Matter is
such as bears against ye weight of ye Whole
air-sphear, and that weight is it, that
keeps the candle In such Compass; Make
the

Where fire becomes luminous there is allwais a Tor= ricellian vacuity

the Weight, and so y^e^ Spring less, & y^e^ flame
will Enlarg, and ~~debilitate~~ /Incroach upon\ it So that
y^e^ force of y^e^ fire, is too hard for the Spring
of the air, and It shall spread and vanish,
all w^ch^ may be seen In the Receivour. So
The force of y^e^ Mo= a burning Coal, w^ch^ is made up of Spiracu=
vement of fire la, at w^ch^ fire is allwais issuing; If that
tending to di= fire hath Not power to drive off y^e^ air sphear,
late & dissipate It ceaseth to be fire. In like manner, a Corn
holds out y^e^ air. of Gunpowder fired, hath power to repell
y^e^ air-sphear, so as to Make room for its litle
orb of fire; and a Mass or charg, is a com=
bination of such powers, w^ch^ Joyne forces &
drive all air out from y^e^ barrells of Gun's, w^ch^
Returning makes that fragor wee all know.

The difference From hence is the Gross distinction between
between heat & heat, and fire. ffor all agitation is heat, and
fire, or flame is hath degrees, and may be Exasperated to such
when /it\ hath force height as to overcome the air-sphear, & then
to throw off y^e^ It becomes flame, or Coal, that is actuall fire, &
air it becomes Not before. It is an ordinary but diverting
fire, Els it it heat. Experiment, to blow out a Candle, & light
it again at the smoak a good distance
from y^e^ candle, or y^e^ coal of y^e^ wick, yet
burning. and the flame will take In y^e^
Smoak, & so pass downe by it to y^e^ Coal &
there

Instance of kin= dling Smoak, and observed that ye transition from smoak to fire & contra, is all at once & Not gra= datim;[365] wch pr/o\oves yt It is from Such caus; & Not chang of ye Matter.

there Sitting become a lighted candle. It is there plaine the smoak takes fire; between wch, that is between smoak & flame, the onely difference is. that the Smoak hath the air Mixt with it; and ye flame hath driven it out, & so holds it. and so ye distinction is Gross, ffor It is ye Same matter In the Smoak, & In the flame; but vastly altered In the appearance, and without any gradation but all at once, Either smoak, or flame; And that is wrought by such crisis of ye air, whither mixt with ye Matter or driven from it.

The Influence of light argues a Great protrusive force in fire, so May well match that of ye air, ur= ging to Infinite.

Among ye Reason's I have for this opinion /one\ is tha[t?] light is allwais a Consequence of fire, and ab[=?] sent from smoak, or matter Not agitated to such a degree, as to throw off ye air-Sphear. (corruscation's I may Consider apart). that light hath considerable force and strength will be admitted; then it is reasonable to thinck, that an agitation that hath force to throw off ye air-Sphear, wch wee know presseth hard, and ballanceth a Columne of Mercury of 29. Inches, should afford such a strength as may affect our sence of seeing, and so lively as the light of a Candle. And that Such ffire allwais takes ye Same degree of strength, and cannot be more, or less lighted, or by any Stronger application of fire, be lighted to an higher

[365] i.e., 'gradual'.

higher degree, but to y^e^ same pitch of strength,
or light onely, argues some Gross, & determi=
nate action, that is Consequent of accension,
And such is a measure capable to resist &
hold out y^e^ atmosphear; wee can find or
discover no other, why then should Wee Not
take that?

The propertys of fire consonant with this hypothe=Sis.

Fire hath So many property's, that I doe not wonder It is a professed art to Manage it, as the word pyroteckny Imports, tho better knowne by y^e^ word Chimistry. but all those pro=perty's, as I can Recollect, are Consonant with this Hypothesis..

1. Not subsist w^th^=out air, & that moved.

1. That fire will Not be without Aire, as hath bin touched; but It is farther to be Condsidered, that there must Not onely be Ayre, but air moved also; ffor without that, fire will Not Continue. This is found by Inclu=ding ~~ayre~~ /fire\ in vessels, & stopping them; the fire shall for want of a Current of air, goe out. w^ch^ proves all the /storys of\ subterranean lamps In sepul=-cres to be meer fables. the reason of this is, be=caus combustible matter is soon discerped, & then dispersed, and such part, as doth not dissipate, w^ch^ is less apt for fire, is left behind

Going out of fire is y^e^ Air En=tring amongst y^e^ fewell

In ashes; and the compressure of y^e^ air, Con=sequent of the being driven off, continues but while y^e^ action is flagrant, ffor as soon as fire hath shaken all to peices, y^e^ air

closeth, & ye fire is out. therefore to Conti=
2. Recruits ever needfull to supply what ye action of fire disperseth.
nue fire, New matter Compustible must al=
wais succeed, so as some is dissipated, and
Reduced to ye forme of air, or ashes, other
Is In ye place, and so the action is Ever both
wasting & Recovering. If a stream of train
of smoak is lighted, ye fire hath soon done
and goes on lighting ye Next, wch seems as
If ye smoak were but a vehicle to ye fire, &
that were ye Same passing along. but it is
Ever new fire, so long as ye pabulum suc=
ceeds. And when ye fire hath consumed ye
smoak down to ye Cotton, there issues a Conti=
nuall recruit of smoak, as ye heat converts
ye wax, but ye fire cannot take it, till it
Issues from ye Cotton; so the ~~firesemes~~ fire
3. fire is a perpe=tuall Current, to vent ye rarefaction wch els would turne to Explosion. so ye matter spent in ye fire goes, & New pabulum comes.
seem's to sitt upon the Cotton, & to be one
flame. whereas it is a perpetuall Current
of matter from ye Cotton, and such part as
is not by ye fire dispersed /Into air\ scatters in the
forme of an ashy smoak, and stick's to
ceilings & ye Sides of rooms /such also is soot in chimny's
\ And that
from oyle-lamps is collected, & used for
black colouring of that name, but ordi=
narily pronounced, lam-black. Now If
this stream failes, ye pabulum, alwais In=
cident & Necessary to fire, failes also &
the

the fire goes out. Many experiments shew this, as If a candle is put Into a botle, & that closed, so as there cannot be a stream of air, In so contracted a room. Niether Can ye pabulum of ye fire rise, Nor the ashy smoak discharg, & so ye fire is choaked. When ye air Is put In a current, the Conterminous parts clasping or Interfering, & so other's farther in, work so as draws out ye pabulum of ye fire. but If there be No stream what should make it Come forth? It will be answered that ye agitation May have power to bring all ye Combustible matter at once to a Con= formity of movement, and that will be fire.

the difference between ye Was= ting of fire & Explosion.

I admitt it. but then wee must Consider there are 2. sorts or degrees of fire, one, that consumes or convert's by degrees, and as Ice melts, till ye Exterior part's are gon the In= terior are Not concerned. this is our comon Culinary fire, the Manner of its acting be= ing Such; but ye other sort of fire that ac= cends ye whole mass, is called Explosion, & must be well weighed in fitt place. And how= Ever air may be necessary to that perhaps

explosion Needs no current, be= caus hath litle or No Continuance.

a current is Not, for it acts uno flatu,[366] as wee shall In due time observe. but Now Wee have ye other sort onely In view, wch is

[366] i.e., 'in one breath'.

is fire that acts gradatim, and hath Con=
tinuance. It is No wonder therefore, that for=
5. blowing Ex= cing a stream of air upon fire, Increaseth
asperates fire. the accension, & fury of it. ffor Considering
how close ye air clasps to fire, urged by ye
comon weight or spring of it, when the
air passeth swift, & In another Manner, then
ye action of ye fire Requires. It must Needs rend
& tear the conterminous parts of it, and so
Exasperate the agitation. ~~of~~ And upon this
use of a Current of air, the whole Conduct
of fire depends; As to all trades yt deal in
fire, Especially chimists /is\ well knowne. And as
air tearing upon fire Increaseth the force of
it, so also fire tearing upon ye Combustible
ye force of Rever= matter, Increaseth & hastenes the accension
buratory fire. upon wch depends ye art of Reverberatory
furnaces. ffor those are onely Contrivances
to Make flame, or fiery stream's beat with
a force upon the Matter wch is to be Wrought
upon. ~~Wch~~ And that Is best demonstrated by
a small tube they call a blow-pipe, wch
A blow pipe is Returning with a Capillary vent, Shall by
a demonstration. ye breath of ye Mouth carry ye flame of a
how ye current of lamp or candle, upon Mettall, and strait
fire & air have flux it, ye was Not to be done with any
force. ordinary fire. the stream of ye flame pas[=?]
seth strait & smooth as the blast directs

it

it. ffor ye stream is In-deed of it self a tube of flame, with ye Small thredd of air from ye pipe In ye Midle, where it maintains a hollow, and so falls on ye Mettall, whereby Goldsmiths are Enabled to Soder small things wch would be wasted In a great furnace.

6. lightness or mounting, Caused by ye aire's weight & occasioned ye ancients to fable an Elementary region of fire.

Another property of fire is lightness, or Intire yeilding to ye Gravity of other thing's, whereby it seems to Mount, and Gave ye ancients occasion to fancy, some orb of pure Elementary fore, to wch, as stocks & Stones to ye Earth, fire allwais tended: Such dream's Come forth, When men leave reality's, & subscribe to Imagination. here are two things to be Considered, ye lightness, and the shape of the flame. as to the former, wee may Reflect that If there be a Space in the air, void according to Torricellius, that, being free, Shall mount to the topp of ye air sphear. the reason of wch is, It is More Compres't by ye air underneath, then above; for there, as neerer ye Earth, ye pressure or Spring is stronger; And farther, It is to be Considered, that the matter, in that Nominall void, is neither heavy Nor light becaus it is ballanc't with ye Rest of its like, Every where disperst In ye air. then by the rising of that void (as I must Call it,) so much air is allowed to discend, wch according

The reason of mounting, of thing's light.

to

to Mechanick laws must operate to Re=
move it. then Next for ye shape of flame,
that would be as drops, & bubles, and Indeed ye
Globus of ye plannets In ye air, round, but
ffor a double Caus; one is this lightness, wch
without more draws it Into an ovall, But
then ye current of air tha allwais attends
flame It is drawne out farther, and accor=
ding to ye Name, becomes pyramidall. all
wch are obvious Effect & need No Explanatio[n?]
but one thing must be Explained, & that is
the lambency of flame; ffor unless it be in
wonderfull stillness of ye air, the flame will
ceas in a sort of tremolous or flapping
movement. this is ascribed to a conformity
In ye flame, ~~to~~ /with\ a movement In the air. ffor
the air drawing ye flame out, beyond the
naturall state of it; wch may be ye conse=
quence of the motion acquired; the flame
is apt to ~~Req~~ Recoyle back towards its own
body, as much too farr ye other way, & then
yeilds againe, & so alternis vicibus,[367] as all
pendulous or Springy movements work.
This is proved by ye Isocronisme of Such Motion
that shews it depends on ye Spring of ye
air, stretching & letting goe by turnes. ffor
It is Most apparent, that ye flapps of flame
very observable In ye burning of candles,
are

The rising draws flame out In length wch els would be orbicular.

The lambency of flame, is a playing upon ye Spring of ye air, when ye flame is drawne out & Returnes, & ye air hath taken a tremolous Mo= vement Confor= mable.

[367] i.e., 'by turns'.

are as the vibrations of pendulums In
Neer Equall times.

fuell collected in centres of vortix= Es. w^ch^ argues it composed of y^e^ Smaller & More Refined, as well as the most de= formed, & Ineptfor fluidity

But Now before wee Goe farther Into this wonderfull sea of fire, wee ought to Consi= der the Nature of Combustible Matter. And wee have y^e^ best discovery of that, by y^e^ places where wee find it; that is neer y^e^ centers of vorticall Motion's, & principally that of y^e^ sun, w^ch^ is In y^e^ Center of the Grand vortex. The rotation of that produceth a separation of the matter one sort, w^ch^ perseveres most that is the largest & roundest, towards y^e^ circumference, and the lesser & most de= formed towards y^e^ center, It is obvious, that round body's may Receiv force In directum but Not readily to turne round, becaus there are No prominences In their sides for body's to bear upon; And If such turne round, they cannot affect others with like mo= vement, for the same caus. but If body's are oblong, flatt, Jagged, or uneven, then one made to turne, shall soon bring all y^e^ rest /contiguously\ about & it to the same pass, and so give and Receiv orbicular movement w^ch^ is that I call rapid, as a Name for y^e^ turning of body's Minutatim,[368] In aggregate, /of w^ch^\ wee cannot distinguish the particulars &

Roundish bodys Inept for fire becaus not rea= dily put into turning Motion

texture

[368] i.e., 'tiny' or 'bit by bit, piecemeal'.

texture. Now that Rapid motion belongs to
Rapid Movem^{ts}. these & not to y^{e} others, is More then, pro=
exciting y^{e} like in bable. And Combustible matter I take to
y^{e} kindling of fire be Such as I have described ~~as~~ driven tow[=?]
ards centers of y^{e} vortexes, In aggregates
and Coagulums. and accenssion or lighting
them, Is done by Application of the like
being In rapid movement; ffor the aptness
of y^{e} matter to be drawne Into a like Cours,
is the Reason of all pabulum to fire; ffor
The many varie- when any Coagulum of Combustible Mat[=?]
ty's of Combustible ter is neer wasted, bring more of the like
matter. & y^{e} fire is Renewed. Now that Combustible
Stuff should be of such various sorts, Some
more other less apt to accend, as wood, some
never failing, as sulfur; w^{ch} name is gi=
ven to all matter properly Combustible.
Some Requiring Great force as Mettalls, othe[rs?]
soon fluxt as wax, Rosin. &c. Some capa=
pable only of Explosion & Not burning
as water, Is Not to be wondered at Considering
y^{e} Infinite variety & accidents of body[.?]
Therefore what Ever differences I hear off
about fire, I ever Conclude there is In the
fformes and magnitudes of y^{e} Matter con=
cerned, a Mechaniq caus for it; altho I
have Not faculty's to Analise it, Ito its
pure principles. So Now I proceed to Explosions.

MFantasmes ~~58 113.~~

Exolosion is y^e^ most stupendious phenomenon of fire.

And of all the Sublunary phenomena these are Most amazing. there are many sorts of Explosion's, /but\ those of aurum fulminans,[369] and Gunpowder, have Not any peer, for sound & Efficacy; the latter is most knowne, and therefore fittest for my porpose to Examine, supposing If wee know one, wee cannot be Ignorant of any, and finding the mecha= nisme, (In probability, or Even possibility) of ~~the Effects~~ Gunpowder Exploded, ~~wee~~ the rest will be No Miracles.

It is a serious thing to Consider, that In a corn or Mass of Gunpowder, there is Nothing but what comes from y^e^ bowels of y^e^ Earth, & hath No forme of fire, more then other com= bustible matter. nor doth any of y^e^ Ingredients ~~cary~~ carry such fury as come from all together ffor Nitre burnes In a lump, sulfur hath a faint flame, & so consumes, y^e^ Coal is farr from removing mountaines, as all these to= gether will, the coal is but as tinder to convey y^e^ fire so as to accend y^e^ brimston & nitre all together, & it is those make the force. y^e^ use of Granulating, is that one Corn fired, may give accension to many others and so y^e^ whole mass, to take fire all at, once or as neer it as can be Contrived; and when

[369] i.e., 'exploding gold', see note at f. 123v in BL Add MS 32546.

The force of Gun= powder, is Not found in ye, caus of accension, Nor In ye materiall action, but is acces= sionall, :qu from whence.

when this prparation is made, what is it that Set's all to work, but a poor culinary spark of fire? And If ye Globe of Earth were of Such composition, It must blow up. that this force is Not in ye Spark, is Notorious Enough; yet that is the occasion, I cannot say the caus of the Combustion. And it is the Case of most objects of sence, wch are the occasion, but Not the Caus of ye Images wee gather from them. a note not much to ye prsent porpose, but apposite to that of perception; then, to Returne to Explosion, the force is Not In a charg of Gunpowder, wch /after ye explosion\ is found In a bas= tion of Earth blowne up with it. Whence is it then? Wee Must affirme ye force with wch a charg of Gunpowder explodes, is accessionall, but to find whence & how, is Extream diffi= cult, and farr from Easy to conjecture with any probability.

Explosion is ye Extream of rare= faction, being Not In time, or very litle, but acts al= most In an Instant

Explosion is the highest degree /or Extream\ of rarefac= tion, ffor as heat Gradually rarifies air & makes it swell, and If confined be More Com= prest & springy, and at length to a degree as to burst some vessells, as thin Glass, that hath not strength to Resist it; So Explosion act's in a very short space, and almost all at once, the same thing In an higher degree. the rarefaction is accounted to act upon

upon fluids, such as are aeriall; but Explosion
act's upon Solid fluids and coagulum's that
have No fluidity at all. ffor water w^{ch} of
all the Compounds wee know is least apt
to fire, yet In an Immens heat, as that of
a furnace & melted mettalls, shall being
Injected In Small Quantity, Explode & blow
up furnace hous & all, & make y^{e} Mettall
fly about In an Infernall manner. So that
Explosion is rarefaction In Extremity, or /neerly\
all at once; therefore wee must Reconsider
the Case of Rarefaction, and see how Explosion
will square with y^{e} Reason's of it; and [wheren?]
there will be differences between them & Why.

S^{r}. Is. N. useth a misleading ex= pression of ra= refaction.

S^{r}. Is. N. hath a strang Expression concerning
Rarefaction, vis^{t}. that it is actio [partium?]
[s...?] mutuo fugientium.[370] w^{ch} is In truth to say
nothing, and yet to seem to say something, a
figure usuall where theree is a good will, but
no Mean's to come at a true notion of any thing.
It is no more, but that y^{e} body Swells, w^{ch} must be
by y^{e} part's lying wider from one, & another then
before they did. he cannot mean they have a
vitall aversion. but admitt that, It fits Not
our buissness, for If Gunpowder consists of
part's y^{t} would fly one & another, why will they
ly Quietly together before granulation when
it is

[370] i.e., 'an action where the parts [...] flee from each other'. I have not (yet) identified this (if indeed it is a) quotation, RN is often imprecise in quoting from memory.

If he mean's Not a sensible aver= sion of ye part's but separation by Impuls wee a= gree.

It is In powder Impalpable. And If it be the Impulses of ye parts upon Each other, that drives them asunder, wee agree In the thing but Not In ye blind Expression; ffor 2. body's never Move and touch, but they fly one and other, therefore it is true that Rarefaction may be from such caus, tho Sr. Is Meant Not thus, and his discourses are like aristotles, rather lo= gick, or giving caracters & names, ~~rat~~ then philosofy, wch should Not name but Explaine things.

Rarefaction In a vessell, is actua= ted from ye agi= tation of Extrane matter, thro ye pores of ye vessell. and is Not from any Intrinsick caus In ye rarefy= able body.

Wee have Sayd, that Rarefaction is caused by the force of the subtile matter, wch permeates all vessells, and Receiving any agitation a= broad, communicates it, to that within a vessel, and that communicates it to ye Inclosed fluid, wch not permeating ye pores, strike ye Sides of the vessell; ffor ye body's moving strike one & other and that must come to ye Sides, unless there were an utmost Expansion, wch is when the parts may move & Not Interfere. So While the parts Interfere, more agitation, must create rarefaction, and If they doe Not Inter= fere, then Rarefaction is Consummate. So that rarefaction is Not from any Internall principle of body, but is from force without accessionally applyed, and as that force May be augmented, so ye force of ye Rarefaction is.

now

Explosions also have their force from the Externall matter, Intersti= tiall to ye air, wch is Influencing from all distance.

Now I account Explosion to be from like Caus; that is from the force of matter without, and not from ought that belongs to ye Explodible materiall, except the Capacity. this Granted it is No wonder that Explosion's have such force, ffor If you Examine ye Influences of Mo= tion about ye World, that every stroke hath Infinite Influence; and that a body May be moved here, In Consequence of some Influence derived from matter resident beyond saturne (If It were possible to trace ye Influences of Some complex movements). as for Instance; the Mat= ter beyond saturne Crouds from the sun, and ye Earth with its vortex, is poised in its place, the former conduceth to ye latter. and In our petit world, a bullet tends to ye center, this

Exterior force brought to act upon any place as a concentra= tion of it, may doe any thing.

may be driven by Influence derived from Mat= ter beyond ye Moon, that tends from it. There= fore If there be a Mean's to bring the Influences of Exterior motion's to bear upon any assi= gned place, It may have any degreee of power. as to dissipate ye Globe of Earth, as well as to rais a bastion, wch is but a clodd.

Small body act litle on great, but If pulverised [thing's?] litle are Influenced

Then I suppose that there is an action in ye very subtile matter, swift as it is small; but hath litle power on Great body's or lumps of matter, as a grain of Sand Signifies litle to a millstone; but If a milstone were pul=

-verised

Thence Explo=
dible matter, bro=
ken by fire, is ex=
posed to ye force
of its like ye
subtile agitated
matter of ye World

-verised a few Graines of sand might make
havock in it. This subtile matter May be a[=?]
gitated under an Influence of an Immens
extent. And the Explodible materiall, May be
of the same sort, or Great part of it so, as
In the coagulum or /Gun=\powder, the subtile matter
wrought Not upon it; but when broken by fire
then the subtile matter layd hold, with all ye
fforce Influencing it, and give's it that power
to Expand. So that when a Mine Springs, It
is Not ye train that doth the work, but the sub=
tile matter disperst In the whole Region roun[d?]
about, Influencing the matter of ye powder
when broken all at once, /fire and occasioned\ by ye
Mixture of dif[=?]
forme Compounds, Nitre & sulfur, with ye tinder
of Coal Every where Intersperst; I should be
Glad to know how otherwise it is possible for an
Extraneous power to act thus upon Combusti=
ble matter, Infusing such power Into it. that

force is Not cre=
ated, No More
then substance,
therefore Must
be derived, and
whence; but from
ye matter apt to
Such motion In ye
ye world, of wch ye
quantity from ye
Extent of Influence
makes up for the
exility of ye parts.

it is done some way, or other, is past dispute. ffor
force is Not Created, No more then body or Space
to serve turnes, but proceeds from Impulses, accor[=?]
ding to ye laws of simple motion, however Com=
plex or Compound ye Case happens to be. So this
power of lifting a bastion, comes Not from the
materiall of Gunpowder, wch is so small in
Respect of ye weight & Quantity It lifts & Moves
that it is as Nothing; therefore it seems Ne=
cessary that this force be derived from much
Quantity

Quantity and space abroad, to hold some pro=
portion with these stupendious effects.

This speculation very scrupulous

I know by my self, who cannot but labour under many objections to this conceipt about Explosion, that other's will put foreward E= now, and some I may foresee, and It May be ans^{r}. As for those Supercilious Expressions of

The dictators or tutor's In philo= sofy, run it down. & defye y^{e} Notion of subtile matter however Manifest

some late authors, that subtile matter is a figment or dream, when they ought to know by y^{e} Magnet & other Naturall action's, there is such. or that wee are Cartesian's; w^{ch} In tutor language is slight Enough; or that Hypotheses are vain /or that these powers cannot be mechanically Resolved\ & y^{e} like; I thinck them Not to Con= cerne us; but If any thing is applyed to the Matter, however violent y^{e} objection is, I Em= brace it, as a freind to right understanding.

The body of pow= der must be broke by somewhat Gross before y^{e} subtile matter can Joyne & actuate it.

1. It might be objected that the supposed sub= tile matter, whose action is so strong as to Ex= cite y^{e} Combustible powder to such a force, may have y^{e} power to tear it in peices, that is Make it Explode, without other application of fire. An answer to this was touched before, and con= sists In the supposed disproportion between y^{e} ~~sup~~ subtile parts, and the coagulum, y^{t} is y^{e} cornes, or Granules of y^{e} powder. to w^{ch} I add farther, the Composition may be so bound

up

up among Gross Matter that the subtile parts could Not come at it. And as to that, wee have this Evidence, flame w^{ch} is y^{e} oyly part of y^{e} fewell, will hardly, and a burning Glass Neve[r?] Imediately Explode Gunpowder,. but It will melt it. And If y^{e} powder on w^{ch} y^{e} powder is lay[d?] takes fire, as it will at a burning Glass, y^{e} least touch of that fire, or of any adventitious spark from a flint, or culinary fire of any sort, In= stantly fires y^{e} powder. w^{ch} shews that somewha[t?] Gross is Required to break y^{e} body of y^{e} powder before y^{e} Subtile matter can Come at y^{e} minute part's, apt to Explode; and If one corne fires, that doth y^{e} Same office to all the Rest; And upon y^{e} accension of much together, wholly depends y^{e} force of y^{e} Explosion, ffor If y^{e} powder be close rammed & so Contused Into less Granules; the fire cannot penetrate, as it doth among y^{e} cornes, to kindle Much together, then it burne[s?] gradually by small Explosions, & is that they Call wild fire.

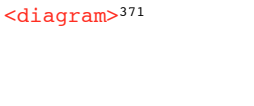
wild fire is when y^{e} Explosion's are peice by peice, & Not all at once.

so train's explode by running on as y^{e} powder leads.

2. It may be objected that the part's of Subtile matter cannot have more force then as a body of such magnitude and velocity of movement as it hath, opposed to any other; and this de= rived Influence from abroad, is Not Intelligible I ans^{r}. that In Complex movements, body's May have the force of many other's, as well as of their

In complex abs= truse cases, bodys act with a long derived force, & are Not as Simple Impulses.

their owne, to agravate the Impulses they make,

 [371]

as If bodys lye in this posture. A strok at A. causeth an Impuls at B. with ye force of more substance then the body B. hath, that is all ye Intermediate body's contribute as More Quantity added to ye Impuls at. B. And what is Shewed here

In a few, is to be supposed Energetick in the Infinite complexity of ye mundane matter Especially ye Subtile parts of it, wch have Comuni= cation by motion all ye world over. therefore Wee conclude that what may be In simple Instances, certeinly is, in such vast Complexity of Motion.

The explodible Matter cannot Exhale, but forces And that is by ye mean's of Grosser matter with it upon wch it bears, wch cannot per= meate Earth, &c.

3. It May farther be objected, that If this com= bustible matter, must be broken, and become small, as In parity, to be wrought upon by ye so small subtile matter. why doth it Not, as that, permeate all vessells, & Instead of lifting ye bas= tion, Exhale thro ye pores of it, & so have No Effect? To this I must answer by Recalling to mind the Reason of Rarefaction. that altho ye Impuls be from Subtile penetrating Stuff, It is the Gross that protrudes, by reason that the Subtile Excites a swifter movement In it. So If the powder were all subtile matter, It might Ex= plode, but Not blow up any thing, ~~but~~ ffor It would permeate all porous bodys. of this sort is ye fire of lightning, wch sticks at Nothing but by accident, and then it Rends all to peices;

lightning hath no Such Gross Mat= ter, & so permeats all things.

And

[371] The first diagram is in pencil and has been subsequently crossed out before being overdrawn in ink.

And such accidents may be a matter In y^e^ way apt to contein or stop it, & then y^e^ violence ap= pears. So I p^r^sume that y^e^ Gunpowder is a composition of matter, part of w^ch^ may be like that Subtile matter w^ch^ Explodes it; and part Grosser, & probably Gross In many degrees, and most certeinly much of it so Gross as Not to permeate Gunn's, or ought y^e^ air doth Not pass. the less Gross May be as a Medium comunica= tive of y^e^ Motion wherever it Comenceth; there is No doubdt but y^e^ beginning is from y^e^ fire that Kindles it, but then y^e^ force is prosecuted by y^e^ subtile matter in it, w^ch^ finding Shift so apt to move snatcheth it along, & that other parts, till y^e^ whole is In so rapid a motion, that the Gros= ser Not capable of venting /otherwise\ is Made to drive y^e^ obstacles away. All w^ch^ force is Not from the first accension, but from the Imens force of the Subtile matter w^ch^ urgeth y^e^ whole, after it is once kindled.

Many Explosi= on's happen ac= cidentally.

4. If it be sayd, that this subtile matter being Every whare dispers't, might accidentally meet with matter apt to Explode, and wee Should have many such, without y^e^ Contrivance of Gunpowder; I answer, true. and wee have Many; what is y^e^ phosforus, that kindles by meer air? and Earthquakes y^t^ are from y^e^ air, come from some accidentall Explosion, so our comon whirlewinds not to mention many accensions In y^e^ air seen

at

at Night, and other's not seen by reason of
Daylight, and it may happen that nitre &
& sulfur mixt come in y^e^ way of subterane=
an fires, and Causeth the great Eruptions at
y^e^ severall volcano^o^s or burning mountaines,
but that such composition, w^ch^ is become an art
or trade to p^r^pare, is not frequently to be found /p^r^pared\
by meer accident is No wonder.

Explodible Mat=
ter Enveloped
with Gross parts
w^ch^ must be rent,
& moved.

5. If the /subtile\ matter have such strength, why doth
it Not break y^e^ Granules of sulfur & Nitre, with=
out y^e^ help of Culinary fire? I ans^r^, that It may
be becaus, the matter is too much disperst, and
acts by points, or very small parts, and also the
composition is bound up in larger body's; but
when y^e^ Composition is broke, y^e^ Subtile matter rush=
eth in; and act's in great Quantity together.

This sort or Rea=
Soning Necessary,
or philosofy, Nay
all Curiosity Must
be layd aside, &
that humanity
doth Not bear.

I am sensible this feild is ffull of thornes, that is
objection's, and It may be say'd In the main, y^t^
all wee can discours of such unknowne sub=
jects, savours of the lunar. to w^ch^ I cannot
Reply otherwise then, that If wee will philo=
Sofize att all, of such ~~portentous~~ stupendious
Effects, and who can forbear, It must be In
this manner; that is /by\ considering how ~~by~~ /with\ Means
of Corporeall powers, such consequences may
be. and If they act in extream minuteness,
wee must Judg by collation with what is Grea=
ter, ffor w^ch^ this Encourageth; proportion and
not Quantity abstract, makes all differences.

1[↛?]24.[372] Fantasmes

All fire is Ex=
plosion in some
degree or Man=
ner. such as are
Most sudden wee
Call an Explosion
others, Consuming
& ye like, as less
Quick.

This of Gunpowder is Not ye onely Explosion
but as I sayd, all fire Explodes; but when it
is slow it hath Not that caracter, & is Called
consuming; but when it is very swift then it
is Explosion. so as Some Explosion's are with
Easy beginnings, other's are Not without grea[t?]
Impuls, as that of water Requires a fiery fur=
nace, to Make it Explode; & otherwise tho
Exceeding hott, & In some measure Macerating
It will Not take ye forme of fire; oyle Explode[s?]
with difficulty, but Easily takes fire. Spirits
of wine, Easily both burne & Explode. but It

ye Effects of Mo=
tion Must be
various. but yt
of powder, hath
plainely ye Means
of explosion More
then any, as ye
Ingredients shew.

is to No End to collect diversity's, since all
things In ye World are so diver's, that scarce
2. minute parts, or Elements of thing's are
alike, no wonder then If ye agregates and
Compounds are so various, & have effects so
different. It is Enough, as to Gunpowder, to Say
that ye Materiall is so contrived, as of all thing[s?]
soonest to take fire, easyest to Explode, and
most violent In ye Effect; therefore most acco=
modate to practice, where such force is Required[373]

of striking fire
& ye Manner how
it is produced.

The last thing I shall touch upon belonging t[o?]
this subject of fire, is ye ordinary mean's of obtei=
ning of it by collision of flint & steel. or what
is ordinarily Called striking fire. This is a
phenomenon, wch hath occasioned Much puzling
as may be seen In authors, who have venture[d?]

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[372] RN's own page number is here overwritten. It is overwritten by the same pen and ink that has been used for the marginalia, and that pen and ink has also been used for the additional text, lower down the page. A similar overwriting occurs on the following two pages.

[373] Here the text, which has been written continuously in a pale sepia ink, at least since f. 252/3, and largely with a broader nibbed pen, is succeeded by writing in a darker ink and with narrower nib. Note the change of subject, the lack of a catchword at the bottom of the page, and the cramming of words into the remaining space over the next two pages.

Note

Most have thought latent fire is In ye Steel, & brought forth by Collision wch is Not So.

peices of ye Mate= riall as Steel are Struck off, and Mel= ted, being Small & In rapid Motion.

Microscopes Shew ye small drop's of Melted Steel upon wch ye fire is Struck.

upon so abstruse a theory; some have fancyed one thing, & some another, cartesius at last is pleased to lodg In a flint certein parts apt for fire, wch are struck out. And by being put Into Rapid Motion take ye forme of fire. I pass by the Elementarians, whose flights are allwais beyond all proofs, and Come to the matter wch is In a litle Compass. ffor the fire is Nothing but part of the steel, or Matteriall whatever it is, yt strikes Into fire, beaten off from the Rest of ye body. In very small parts, and withall, so agitated with ye violence of ye Stroke /partly by friction In ye parting, & partly by ye Swiftness of its passage ye movemt\ that ~~ye turning~~ amounts to ye force of fire, & ye Small peice of mettall fluxes; wch is mainely brought about by ye passage thro ye air, that Exasperates ye fire.

That this is thus performed, 2 experiments ve= rifye, the one is of Microscopicall Inspection. ffor If with a Comon flint & steel, fire is Struck upon a sheet of white paper, ye place where ye sparks light, will appear by a litle [.....?] of ye paper. those viewed with a good Microscope will Shew In Each of them, a Small lump of ~~sht~~ steel round, & smooth as a shott, or rather like the melted Iron yt fly's from a blacksmith's work, & stick's on ye walls, as shott upon wax, neer ye anvill. this demonstrates, that the peices of steel struck off, are fluxed In ye air, & so fall [rand?] as dropps are In ye air

1[.?]26. Fantasmes

File dust dropt on a Candle accend & flux In ye Same Man= ner, as Spark's from a steel.

The other Experimt, wch shews how Iron In a small body are apt to flux, and that No= thing can be more like to ye Sparks from a flint & steel, then small peices of Iron [fluxing?] Is this. take Comon file dust, and drop it lei= surely over a Candle. the peices of Iron, will be Strangely Ignited. that is, as it were take fire, wch is strang of Iron, wch requires So Much Heat to make it Red, & Much More to flame but ye current of ye heat In ye Stream of a candle, yt tend's upwards, and the fall of ye Iron agt it falling downewards, doubles the Reverberatory, and makes ye Iron actually melt and Shew in frequent sparks as are very Surprising: all wch Examined by ye Microscope will be found pellet's of fluxed Iron, as before. who then Can doubdt, but these Spark's one way and ye other, so Exactly alike, In Substance & Shew are not actuated In ye Same Manne[r?]

To confirme this I observe, that Nothing tends Mor[e?] to heat and accension, then tearing off part's of a continued body, as the very bending iron heats it, becaus the part's rend one from an other, & so ye mettal is torne off by ye flint, that Drives parts & doth Not cutt them off. It is observed of the phos[=?] forus, that the least rubbing, or passing any thing over it, set's it In full fire. whereby there is Evidence of more motion and violence raised by ye parts of a convulst or contused body, then our Senses discover.

Resolves. ~~39~~ ~~1~~.[374]

Of phenomenas considered In them Selves, without any Reference to our Imagination.

I have distinguished the phaenomena of nature Into Such as are perceived thro some Image of ye fancy, wch is Not In the object, as light, sound, &c. and Into such as are perceived of themselves, all ~~such~~ /those other\ Ima=ges substracted; the former I call fan=tasmes; becaus ye object is one thing, and the sensation another; These I choos to call Resolves, being designed as ~~an~~ Essays ~~ffor~~ of Naturall causes of Effects, whose appea=rance is conformable with their being; And concerning wch, all Imagination's are lay'd aside, and the attention is wholly to the thing, as it really Exists.

The Baroscope ye most Instruc=ting as well as usefull Experi=ment.

Of these, None can competition for pri=macy with the Mercuriall Baroscope; an Experiment wch, ffor discovery of Nature, hath outdone all that have bin made since Naturall philosofy hath bin a study, as will appear In ye series of this discours concerning it. I shall Not stay to teach or describe ye /ordinary\ fabrick of ye Instrument, ffor It is Now as comon as clocks; And None Will have patience to peruse these paper's, who ~~is~~ /are\ not well acquainted with it. but In Re=gard there are severall formes of it, wch are Not all so ordinarily knowne, I/t will\ ~~Shall after some other discourses, leading to it~~ /be Requisite to \ make

[374] The writing on this page returns to the 'normal' of the previous pages (up to f. 302v). The British Library corrected (i.e., crossed out) numbering in pencil starts here at ~~39~~, and RN's own numbering starts at 1. Once again the marginalia and corrections are in a different ink (which happens to be, once again, darker).

make some discription of them, that their differences may be knowne, ffor some Consi[=?]derable Conclusion's will depend on them.

The part's of y^e^ Instrument, & of y^e^ first Invention.

The Instrument ordinarily Consists of two parts, a tube, and a stagnum. The tube is usually 40 Inches, & filled With mercury and so Inverted Into y^e^ stagnum /of\ ~~having~~ mercury also, that No air Get's Into the tube. then y^e^ Columne of mercury will fall downe to a certein length, as about 29. inches, and after some undulations will setle. No air (considerable, but some will Escape by y^e^ sides of y^e^ tube, & out of y^e^ body of y^e^ Mercury) getts Into y^e^ tube, so the Space above the mercury, however larg, Will be derelict as to air, and is called y^e^ Torricellian vacuity. becaus that worthy person In search of vacuity fin=ding this effect, thought he had made a full discovery of it. and accordingly pub[=?]lished it, The gentlemen of our Royall society first found that the station would vary, to neer 3~~0~~/1\ inches upwards, & neer 28. downewards, but No More. And they were at great loss for diver's years, as appear's In y^e^ Earlyer transaction's of their society, what account to give of

that

that wonderfull, & (then) unaccountable
chang, & they mumbled it as an ass doth
thistles, uttering Nothing but doubts and
Querys. All were of accord that the derelic=

The derelicted Space No absolute void, but Repleat with Interstitiall matter,

ted Space, was No absolute void; but onely
as to the gross air wee breath, w^{ch} was ma=
nifestly Excluded from thence. This gave
occasion to consider y^{e} Nature of air, More
then had Ever bin done In y^{e} World before,
And the Noble M^{r} Boyle, one cutt out to
Improve discovers/ys\ and hints, by Exquise/it\
Experiments; contrived a pump air-tight
w^{ch} would draw from a vessell almost all

The air pump had a better Com=\mand of such voiding of air

the air that was In it. This was to Imi=
tate the derelicted space, and to prove some
Effects in it, w^{ch} could Not well be practised
In y^{e} baroscope. It became a setled Conclusi=
on, that the void was supplyed, with a
matter Interstitiall & more subtile then air,
permeating the Glass vessell, as air perme=
ates wool, or thornes. And they found that

The /inward\ air to be Elastick, & ever under pressure,

Air as other body's had weight, and that
the whole body of air about y^{e} Earth, was
compressed; and under a perpetuall ten=
dency to dilate; And Never failed to
shew that Effect, when way was made
by Removing obstacles, that is the air

it

itself, In any determined or Included
space; ffor whereas before ye air wherever
it had Comunication waS all under the
sam Compressure; If the weight of the
Generall air bore upon any /out\ Side of a vessel
the air on ye Inside sustained it. but If ye
air of ye Inside could be Evacuated, then
It would be proved that ye vessel could or
could Not Resist ye weight of ye outward
air. by such experiments they found that
the weight of ye air had a certein strength
wch by any greater was subdued, and all
less yeilded to it. And No Measure was So
The mercuriall height ye best gage of the force under wch ye aire is Compres't.
certein as the tube of ye baroscope. ffor ye
weight lying upon ye Mercury In ye Stagnum
squeezed it, as Every thing els, that susteined
it. but ye Mercury being a yeilding body,
and there being way made for it, in the
derelicted Space; /ye air\ prest it up ye tube, untill
at a certein height, ye Mercury In ye tube,
with so great a weight, pressing downewards
made a ballance; & there fell /to be\ ye Station of
ye Mercury In the tube. So that the height
of the Mercury In a perpendicular gage,
was also a gage of the Airs weight, And
that is ye Solution of the Mercury standing.

Resolves. ~~41~~ ~~5~~.

Hence follows y^e^ airs Spring or Elasticity.

It was found by an harmony of Experi= ments, that the air lying under y^e^ pres= sure of its owne weight, had a perpetuall Conatus to dilate; w^ch^ is called y^e^ Spring of y^e^ air. ffor as any Mettall spring pres't downe by a weight, as that is Removed Shall rise; And the force of Rising is allwais E= quall, or ballance, to y^e^ weight y^t^ holds it downe. So the air hath allwais a Spring Equall to y^e^ barometricall mercury, and no more. Hence y^e^ air is Reputed an Elastick body; wee must take Notice of y^e^ philosofick language, tho my designe is to write vulgar

The Surprising power of heat & cold to aug= ment & abate y^e^ airs spring.

English. They also find, that air will Swell with heat, and shrink with Cold, and Not a litle, but so much as is surprising. this is proved by many Experiments, all of w^ch^ have air Included In Some vessell; as a bladder, for Instance; upon the access of warmth, If y^e^ bladder be flaccid, It Shall Swell and te turgid; If y^e^ heat be Increas't ~~It May be,~~ /perhaps,\ burst; If y^e^ heat be Removed then by degrees y^e^ air shrinks & y^e^ bladder becomes flaccid againe; and upon Making an Intens cold, y^e^ air shall be almost lost. while it is all y^e^ Same substance, but onely altered according to Rarefaction & Condensation

.I.

6. Resolves.

An experim^{t} Related of the Baroscope, subjected to y^{e} Extreams of heat & cold & y^{e} Consequences.

I Made an Experiment So apposit to y^{e} porpose in hand; I shall here Relate it, with all its circumstances, and leav y^{e} application to y^{e} Sequel. I Erected a baroscope in y^{e} flas[k?] comonly Called a florence-flask, so as the Stagnum was at y^{e} botom of y^{e} flask, & y^{e} tube stood upright In y^{e} Neck. Then I brought a wett bladder /being perforated for y^{e} porpose\ over y^{e} tube, and made a ligature of y^{e} bladder upon y^{e} tube and upon the Neck of y^{e} flask. so that all comunication with y^{e} outward air was Intercepted by y^{e} bladder; ~~as It will doe, so applyed~~. Here y^{e} Spring of y^{e} air was Shutt in, and as the Elasticity of y^{e} outward air was at that time, so was y^{e} Spring of y^{e} Inward air also[,?] one being a peice, taken off y^{e} other. Now If I could Make the air In y^{e} flask shrink, y^{e} Mercury must need fall In y^{e} tube, and y^{e} contrary upon Swelling of it. I Gatt snow & Salt, and dashed both by turnes upon y^{e} flask

upon Cold, y^{e} Mercury fell, & Much wett generated.

the first thing observable within y^{e} flask was a sort of mistyness, like the dimness of a Glass filled with cool wine. this went on and the mist on y^{e} flask within grew more gross, at length small dropps appeard and a Coalition of them made great drops run downe, so as to breed manifest water within the flask, y^{t} fell upon y^{e} Mercury there.

And

Resolves[375] ~~41~~ ~~7~~.

And observing ye tube, I found ye Mercury fell
all ye while, and wee brought it downe Six
Inches lower then the former station. by this
It was manifest, the cold shrinking ye air
within had weakened ye Spring of it In Such
proportion, less then ye air with out, as ye falling
shewed. then with a penknife I toucht ye
bladder, (wch, by ye way, was drawne Into
ye flask to a strong tension,) and Immedi=
ately ye mercury rose to the first station.
Then I Repeated ye Expermiment, with like
success, and Instead of cutting ye bladder
Upon Heat ap= I brought hot water & powered upon ye
plyed, ye Mercury flask; And It was plaine how all Mistyness
rose & ye Water that was within went away, and ye water
Dryed up. bredd by ye Cold dryed up; and observing ye
Mercury, It rose all ye while, and Wee Moun=
ted it above ye first station above six Inches
As wee forbore ye heat It sank by degrees,
and augmenting ye heat It rose againe,
with ye Constancy of a beam & scales. and
ye bladder Instead of being Suck't In, was
swelled very hard outward, and giving it
a prick, ye Mercury forthwith subsided to
Its first station. This Experiment hath No=
thing nice or difficult In ye practise of it, but
Is wonderfull declaratory of the New
hypothesis

[375] At the top of the page, centrally and directly above this heading, a word (it could be 'Fantasmes') has been rubbed out.

hypothesis of y^e^ air, and how vain the old
subterfuges of suction, & fuga vacui[376] were.

Discovery of the air Sphear, and its determinate height, by y^e^ Ba= rometer lifted up & by lunar Eclipses y^e^ penumbra being y^e^ shadow of it.

The Caus of this adjustment of the weight &
Spring of the air comes to us by another disc=
very, and that is of the atmosphear, w^ch^ I choos
to name more properly y^e^ air-spear. It is
found that upon high places the Mercury
stands higher In the Baroscope, then In the
lower. the Most Worthy Coll^n^ Windham of
Salisbury,[377] assured me that by Reiterated &
carefull Experiments, he found that between
the height of the pinnacle of the Cathedrall, &
y^e^ floor of y^e^ church, there was 1/10. Inch difference
Then the tube by being /continually\ raised, must /at
length\ come Into
a place /at some certein height\ where y^e^ mercury shall
levell with
y^e^ Stagnum. for the progression Requires it.
And such place is the Extream height of
that sphaer of air /(w^ch^,\ by pressing, is the Caus
of upholding y^e^ Mercury. And what that is,
is Calculable, from y^e^ height of the tower &
the 1/10 Inch, compared, with Consideration
of the rule of weight decreasing upwards.
but there is No need of being Nice In y^e^ Matter,
It is enough it is discovered, that the air=
Sphear is of a determinate height, And that
is sufficiently demonstrated also by y^e^ lunar
Eclippses, ffor the penumbration, is y^e^ Shaddow
of y^e^ air Sphear, w^ch^ not being so transparent
as

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[376] i.e., 'fleeing the vacuum', the scholastic notion that nature abhored, and therefore fled from, a vacuum.

[377] i.e, Colonel John Wyndham; the following information from an entry for his son, Thomas Wyndham, in the *ODNB* online (consulted August 2014): 'John Wyndham of Norrington, a colonel in the army and MP for Salisbury in 1681 and 1685'. It is most likely that the experiment was carried out under the direction of Bishop Seth Ward (1617-89), Bishop of Salisbury from 1667, former Savillian professor of Astronomy at Oxford, and a founder member of the Royal Society. Wyndham took a reading at ground level, and part of the way up the spire. He knew the heights involved and was able to observe a fall in the height of the mercury corresponding to that height. RN implies that the mercury would reach a height of zero (i.e., be level) at the very edge of the atmosphere. That zero point, using the figures of one tenth of an inch per 400 feet (the approximate height of the spire) would, even without correcting for 'rule of weight', take us up to at least 120,000 feet above the cathedral floor. A full account of the (then best guess at) relation of altitude to air pressure was communicated to the Royal Society by Edmund Halley (Phil. Trans. 1686 vol. 16 no. 179-191 104-116), which RN must surely have known

as y^e^ Ether, Cast's a faint shaddow on y^e^
~~Eart~~ moons surface, w^ch^ is very distinguish=
able, and shews (grossly) y^e^ proportion it
bears to y^e^ diameter of y^e^ Earth. Wee may
The Crepusculum & Refraction's of light from y^e^ Starrs shew y^e^ air Sphear a body distinct from Ether.
also observe by the Crepusculum, that there
is Such a vaporous body about the Earth,
and that it mounts, not high. ffor what /it\
doth at y^e^ horison /(\where much and y^e^ thicker
part Interpose~~th~~/ing\, almost obfuscate/s\ y^e^ Sun,/)\
is scarce to be discerned, when y^e^ sun in
In y^e^ Sumer Meridian. And the Notorious
Refraction's of light from y^e^ luminarys of
y^e^ heavens, coming to us obliq Sufficiently
prove a distinct body of a different Con=
Sistence from y^e^ Ether, Encompassing y^e^ Earth.
And that it is Not very deep, becaus a Mode=
*q^u378^* rate Elevation above y^e^ horizon much abates y^e^
Refraction.

compression of y^e^ air is from y^e^ weight of its owne body, & so by distribution of part's, gaged accoring to y^e^ perpendicular Columne.
So here is an Intire sphear of air about the
Earth, w^ch^ allwais presseth it self, so as y^e^
lower parts bear, & are comprest by y^e^ supe=
rior, and th earth & sea, are y^e^ base and
sustein y^e^ whole. for w^ch^ reason it is that
wee comonly say any part of the Earth sus=
teins y^e^ Columne of y^e^ air directly above it.
w^ch^ is in a manner true, ffor If y^e^ whole base
sustein y^e^ whole sphear of air, then part
bears

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[378] *q^u^* in same ink as the main text.

10. Resolves

bears part according as ye proportion is to ye whole. therefore as to ye measure of Incumbent force it is the colume that determines. but If ye conveyance of ye force could be traced, It would be found that ye Matter in ye Columne Influen=-ceth laterally as well as right downe, but bing pay'd againe by others, as to measure as I sayd, It amounts to ye Same as if onely a columne pressed right downe. ffor this reason the diameter of ye tube Inlarged by wch Much More of ye Mercury is conteined, doth not abate any thing of the height of the Standing of ye Mercury; but a tube of 10. In. diameter, shall stand as one of 1/4. In. ffor If ye mercury weigh more, the Columne is Grea=-ter, & would be as Effectuall, If a tube were a larg as a church steeple. And If ye Instru=-ment be placed high In ye Columne, the weight is less, for plain reasons already touched.

Inlarging ye tube ye Mercury hath greater force to sustein it, be=-caus ye colume is also Spread.

but lifting or de=-pressing, lifts or sinks ye mercury becaus ye Columns is Shorter or longer.

And In this condition of pressure, the air & all other fluids are alike, tho Not Elastick as ye air is. ffor If a vessell be lett downe Into ye Sea to a great depth, the water accor=-dingly presseth all part's of it, and If any part yeilds, it Shall be driven, and If ye whole be too weak for such burthen it shall break. a good freind of Mine,[379] In a voyage from Const° diverted himself, with letting downe closed flasks

pressure of air parallel's with that of water experiemented In ye Sea.

[379] i.e., RN's brother, Dudley North.

flasks & bottles with y^e^ [dippsea-line?], Into y^e^
sea, and that sometimes 200 yards. the flasks
would sometimes burst, but Not y^e^ botles, yet y^e^
corks of one & other ~~that held,~~ Never failed to
be driven In by y^e^ weight of y^e^ water. So vaine
was y^e^ Man that wrote of y^e^ Non gravitation
of fluids.[380] And as In water, the force of pressure
is /according to\ the aperture by w^ch^ it may pass, w^ch^
artists
call y^e^ valve, or vent, As In a tunnel, tho it
holds as a cone Inverted, yet No more presseth
at the cusp, but y^e^ quantity of a Columne
from y^e^ vent, to the top, In a perpendicu=
lar gage. And every part of a body Immerst
In water, bears of y^e^ weight, So much as that
part, If it were an aperture, would let pass
according to Such Columne. So it is In Every
Respect In y^e^ air; ffor that hath force acco=
ding to y^e^ Entrance Into y^e^ tube; and Is More
or less as that is wider or straiter. But If it
~~Happen's~~ /proves\ that y^e^ tube is larger then y^e^ En=
trance from y^e^ Stagnum, as Comonly happens,
that Makes No alteration In the Standing
ffor the pressure tho It be but upon a capil=
lary Entrance, shall work upon y^e^ Stagnum
till it hath protruded such Quantity by a
continuall Current Into y^e^ tube, as shall
rais y^e^ upper surface In a perpendicu=
lar gage to a due height to ballance y^e^
force

The laws of Hy=
trostatick's have
place In air.

[380] i.e., Matthew Hale author of *An Essay touching the Gravitation or Non-gravitation of Fluid Bodies, etc.*, London, 1673. See note in BL Add MS 32546, f. 53r

12. Resolves

The gage of all pressure of fluids is as ye Gravity yt Causeth it, by a perpendicular Gage. so curvitys, meanders, or lea=ning of ye tube, hath No Effect (but friction), & ye perpendicular makes ye Gage.

force below, and If ye Mercury is above that height, It will Not ceas to run out, till it is reduced to it. whereby it appear's that the Manner of ye Mercury Entring is Not Mate=riall to ye Instrument, ffor any Entrance, if competent, whatever ye tube is, is Sufficient. but the height In the perpendicular, is con=stant to ye Caus, however it is disposed. ffor If ye tube be curve or leaned in one side the Mercury will Enter till that height is Gained, and upon righting it againe, Issue till it is Reduced. And thus wee may observe that the distance, between ye two superfices ye upper an ye lower, or rather between the [planes?] of ye one and ye other horizon=tally taken.

when ye Station va=ry's, part is In ye uper superficies Sinking, & part In ye lower, rising In proportion to ye Extents of them.

Hence it appear's also, that the variation of the station, when there is caus for it, by a greater or less pressure of ye air. doth Not shew onely at ye upper superficies, as now vulgarly is Expected, and ye Index declares. /but below also\ ffor part /of ye variation\ will be In ye Stagnum. becaus If the Mercury vent's from ye tube by falling it must rais ye Stagnum, and that adjusts ye Columne, as well as ye falling above. and If the ~~superficies or~~ diameter or /superficies\ content

content of y^e^ stagnum, be equall to that
of y^e^ tube above, then just half of y^e^ varia=
tion will shew above, & half below. but If
the stagnum spread much, as usuall it
doth from a strait tube, then y^e^ variation
as desired, will appear most above, and
litle below, because Much sinking there, will
by y^e^ Mercury vented rais but a litle below;
It is the same thing, If the stagnum be ve=
ry Contracted,and the superficies of y^e^ Mer=
cury aloft much Extended then y^e^ varia=
tion will appear cheifly /not aloft but\ below. ffor a litle
from ~~thence~~ /above\ will rais much In y^e^ Stagnum.
The Consideration of this gave occasion to
dispose a barometer with an Index, as
a clock to shew very Nicely all y^e^ movem^ts^
or changes of the standing, as will happen
from causes to be declared.[381] And that is Cal=
led a wheel barometer; and Contrived so
that y^e^ upper superficies is In a bolt-head
of any biggness, and the stagnum is in
y^e^ tube Returned as a Syphon upwards. upon
w^ch^ lower superficies or stagnum, a plum=
met of ~~ler~~ Iron or brass was let fall, & being
brought over a Nice wheel susteined by a
Counterpois, so y^t^ y^e^ mercury rising In y^e^
syfon lifted up y^e^ plumet & turned y^e^ wheel
w^ch^

Hence y^e^ Inven=
tion of y^e^ Wheel
Barometer, &
y^e^ fabrick des=
cribed.

[381] *See Phil. Trans.* 1665 vol. 1 no. 1-22 218-219, (accessible online at http://rstl.royalsocietypublishing.org/content/1/1-22/218.full.pdf+html?sid=fceb56f3-39b6-4911-8044-56a8c1af6672).

wch carryed an Index without; This Is ye best application of ye Invention, but somewha[t?] costly, therefore Not used. Sr Sam: Moreland[382] Had another device. wch was to Suspend a

of the Balance Baroscope & ye Hydrostatick considerations Relating to it.

Barometricall tube at a beam with a due Counterpoids, and allowed a stagnum of a great depth. this Introduced many hydr[o=?] statick points, for ye tube rising & sinking In ye Stagnum, concerned a comparison of weight between Glass & mercury. but I am not to criticise on such Inventions. It is cer[=?] -tin, at ye other end of ye beam, wch had the Indicative part, ye space of ye variation was much Inlarged, but for like reason's that Invention also was layd aside. I shall Men[=?] tion one More becaus It affords us some Spe[=?] culation, as well as proofs of what hath bin Sayd.

of the pendant Barometer; wth= out a Stagnum becaus ye Mercury In a small body hath Not force to break away, & run, but sinks & useth all in a body.

This is Called ye pendant tube; And the use of it depends much upon ye Exility of the channel of it, I thinck they allow about the bigness of a comon straw. It is filled, and sus= pended without any stagnum, having ye orifice aloft closed, with a space derelicted and the orifice below open, and a considerable space between ye orifice and the mercury. In this ye rising and falling will be much more then. 3. Inches, and ye Mercury doth Not drop out

[382] Sir Samuel Morland, 1625-95, mathematician, courtier, diplomat (and spy), and inventor of numerous hydraulic and mechanical devices and machines.

drop out below, all w^ch^ together is very Mis=
terious, and deserves an Eclarissement of the
many thing's that belong to it. first the reason
that y^e^ Mercury hangs doth Not fall out as in
a Greater tube it will, (by stealing downe from y^e^
side, when taken out of the stagnum.) is becaus
the body of Mercury doth Not readily part
but (as water) clasps close together, and In small
Quantity's will be round as drops of water in y^e^
air. Wee see that roundness will not hold in
larg Quantity, when effused upon a table, but
onely about y^e^ confines of y^e^ substance with the
wood It will compass a litle the rest towards
y^e^ midle will fflatt. And that is done by the
weight w^ch^ overcomes the caus that tends to
round it, but In small quantity the rounding
principle is as strong & y^e^ weight less, so that
very small dropps will appear Exquisitely
round Whither moving or resting. thus In y^e^
small tube, the weight tends to part y^e^ Mer=
ury from its body, but In a small space ~~the~~
it is so litle, that the tenacity getts the better
of it. for y^e^ tenacity is y^e^ Same, according
to y^e^ property of y^e^ Mercury small, or great
but y^e^ weight, or separating force is less accor=
ding to y^e^ deminution of y^e^ Substance. And here
y^e^ Same principle I disclosed of the variation
of powers or perseverances, from y^e^ proportion
between substance & superficies, hath place but

The reason, is
grounded on y^e^
failing of force,
In small things
before demon=
strated

16. Resolves

but I doe Not Inlarg with applications. thus
y^e Mercury is suspended In y^e open tube be=
caus the totum cannot (as y^e Quantity /or diameter\ is to
be adjusted) discend ag^t y^e pressure of their,[383] &
there is Not a force from y^e Weight of any part
exposed to break from its body.

The friction hath power on so Small a colume of Mer= cury, and Makes it move by starts for once Moved it passeth Easyer then is Sett going, becaus y^e force of its owne body Impres't Car= ry's it on.

Next the variations shall happen In the Same
conjunctures, as In y^e Comon tubes; but It Shall
Goe by start's, & not creeping, and In the
whole rise & fall much more the 3. Inches.
As to the starts that is plainely from y^e frictio[n?]
of y^e Mettall ag^t y^e canall of y^e tube. ffor the Mer[=?]
cury adjusted hangs In a just ballance with
y^e force or spring of the air. If that ballance
changeth, by y^e languor, or Quickning of the
Spring, many degrees of force are required to
Conquer that friction, & then when it is once
loos, & y^e Mettall In Motion, y^e Vis Impressa
hath y^e better of y^e friction, and It will Swing
beyond its poids, and so undulating ~~to &~~ up
and downe setle, but probably Not In exact
place, for y^e Reason given. That this friction is
very Considerable, is proved by a Comon tube

The reason of y^e mercury, at first Erection, hanging to y^e top of a Com= mon tube

w^{ch} Erected [~~Will~~?], so temperately that it hath
No Concussion, y^e mercury Instead of falling to
its place, Will hang to y^e topp; but then a small
movement will /loosen & so\ Reduce it to freedome; this
accident was very amazing, when first ob=
served as appear's by the transaction's,[384] but hath
no

[383] the air?

[384] I have not been able to identify the *Phil. Trans.* article/letter to which RN refers. A pendant barometer (with exactly the problem of mercury suspended by the vacuum and liable to fall out if shaken) was invented in 1695 by Guillaume Amontons, 1663-1705, a French inventor. Amonton was a member of the Académie des Sciences and developed (or rather, rediscovered Leonardo da Vinci's) Laws of Friction.

no More Riddle the I have observed.

This differ's from other barscopes for y^e^ Quantity is allwais y^e^ Same. and y^e^ variation Shall be in greater Space.

There are two thing's singular In this sort of baroscope, ffitt to be made Intelligible, one is, that admitting a just ballance between y^e^ mercury & y^e^ air, w^ch^ keeps y^e^ Mercury in a sta= tion, when a caus Intervenes to alter that balance, and y^e^ Mercury riseth, It shall Not mount to y^e^ topp, altho it is allwais y^e^ Same Quantity, but after some space risen stop a= gaine; and so for falling Not proceed to the bottom, but stop by y^e^ way. y^e^ other is that y^e^ Mercury Shall rise and fall much more then y^e^ upright standing tube, tho one Comon caus governes both. I thinck the first of these knowne will reveal y^e^ other, and for that let us consider y^e^ Matter In y^e^ Extream. Suppose y^e^ tube were pendant from y^e^ top of y^e^ air sphear. A length of mercury, w^ch^ would be resisted by y^e^ air, neer the surface of y^e^ Earth, being raised up to the sumit of y^e^ tube, would be much too strong for y^e^ faint Spring of the air there; and Consequent= ly Sink downe, and drive y^e^ air afore it, till It Meet a spring In y^e^ air, y^t^ is a Match for it, and then it would come to a ballance; And so wee must assume that the same length of mercury, in a place more raised, Requires a stronger Spring of air then In a lower place. therefore when

Its higher stati= on In y^e^ air Sphear hath a weaker Spring

the

18. Resolves

the Spring of y^e air, is somewhat Invigorated
The mercury rising, Gaines force to Resist it
accordingly; and If y^e Spring languifies, then y^e
mercury falling, is Resisted at such place, as
makes y^e ballance. so it is Not true, that the
mercury is the same in all heights /as to force\ tho it be
y^e Same as to Quantity. and the same length
of mercury thus shifting between higher & lower
answers y^e accidentall variations of y^e air, In
more & less strong. Then that the space In=
dicatory of this variation, is Not y^e Same as In
y^e upright standing tubes, but Much more, this
reason may be given. In the standing tube the
Comparison is of weight; such a height of Mer[=?]
cury ag^t the whole superimpending Colume
weyght ag^t weight /or Spring\. but In y^e pendant barome=
ter the Comparison is onely of place, and y^e
weight is y^e Same. or thus, In the standing ba=
roscope the strength of both body's chang. as
by rising, y^e Mercury is heavyer, and y^e spring
of y^e air stronger; but In y^e pendant baromete[r?]
the spring may chang, but the Mercury hath
No alteration, ~~but~~ /onely\ In place. ~~onely.~~ lengthening
the mercury In y^e tube, and setting y^e Same in
an higher place, are very different accounts.
and one describes a larger space then y^e other,
and that belongs to y^e pendant barometer.

In y^e pendant ba=
rometer, y^e com=
parison is gover=
ned by place, but
In y^e upright, by
Quantity as well
as place, w^{ch} Makes
y^e former have
a more dilated
variation.

Resolves. ~~48~~ ~~19~~.

When y^e^ airs Spring alter's, y^e^ Mercury takes a New place to ballance it. but If you move y^e^ Instrum^t^ to an higher place, y^e^ Spring of y^e^ air, is not varyed Much In Such heights as comon houses have, so y^e^ alte= ration of y^e^ Mer= cury, consequent is Not discernable.

Some may thinck these matters trifling to dis= cours of, but I cannot but Esteem them most worthy to be declared and understood, tho If It may be done In fewer words, It were better. others May object, and say that If you carry the pendant barometer Into an upper room y^e^ Mercury Must fall, and very Much, being Such a number of Inches heigher In place then below. I answer that all baroscopes stand higher In an uper Then they will stand in a lower room, but y^e^ difference is so litle In that Space, It is Not to be seen, as It was In y^e^ height of salisbury Spire. And It cannot make such a shew In the pendant barometer, as, at first thincking, May seem. becaus when you lift y^e^ whole Instru= ment, it is Not as lifting y^e^ Mercury, while y^e^ Instrument keeps place. ffor y^e^ Spring of y^e^ air is very neer as strong above as below, and So May as well support y^e^ Mercury, as /before\ it did, ba= ting some Imperceptible alteration, w^ch^ was allowed; the ballance is between y^e^ Mercury In its place, and y^e^ air. the latter becoming Stron= ger /y^e^ [increas?]\ takes an higher place, and Comes so to a parr. but If you translate y^e^ Instrument with the same Strength on y^e^ part of y^e^ air. there is No reason at all for the mercury rising or falling but y^e^ Same ballance, saving that litle, Remaines.

20. Resolves

The caus, & use Remaine, vist what raiseth ye mercury, & what follows.

Thus much of ye fabrick of ye Instrument and ye Manner of it working; two porposes Remaine, one, the caus of the alteration's that appear, and ye other ye use, by application to the weather/to foretell ye changes of it\; ffor that is a property so much desired, and also so Neerly performed by ye baroscope, that it is become Now an ordinary utensil, as clocks are, In Most Mens houses, yt are able to purchas it; ffor Much of that kind is expected from it; With what reason, and how farr it may be Relyed on, Remaines to be shewed.

The caus is the Spring of ye air Invigorated by ye weight of it. but how is that.

As to the caus, wee have Gone so farr, as to Shew it is ye weight, and consequently ye Spring of ye air, that holds up ye Mercury to its station, And that rising, and falling, Indicates certeinly an alteration of that caus In degrees of more, and less, and that ye alteration is adequate in its force to ye alterations of the mercuriall Station; but then what should be the caus of this alteration of the spring of the air. In order to this ~~wee must~~ and what Is to follow, wee must take an account of ye air, and, as neer as wee can, Conjecture ye nature of it.

The air is Mostly of water Evaporated.

It seem's to me that ye air In the generall is water Evaporated, that is rarefyed to such

such degree, that it leavs ye forme of a set=
led fluid, and taks that, I call an aeriall
And by that be= fluid. the Consequence of wch is, that whereas
comes Elastick, water may be warmed, but In that forme,
and Subject to Not rarefyed, but when urged So much as
swell with heat to become vapour or air, then Every degree
& Condens with of heat Rarefyes it More, and on ye Contrary
Cold. cold condenseth, and at length Reduceth Much
of it to water againe. Much of this cours
as to water, & air, is proved by comon dis=
tillation, ffor that, by heat, raiseth water Into
Air by Cold Con. vapour; and ye cold-head of ye still meeting
densing it becomes that vapour, Reduceth it to Water againe
fertile of water. & so conducts it Into vessells; but of this More
proved by distil= anon. That air is Mostly water Evaporated
lation. I argue ffrom the Genesis of it. wee may observe
that water it self, or any thing wett, will by
a moderate heat Evaporate & turne to air. &
Even ye heat of the sun Makes great dispatches
that way, wch they call, Drying. I Consider that
there is litle difference between ye Materiall of
air, and Earth, but In fluidity; and so between
an aeriall, & a setled fluid, but what is the
Consequence of a rapid movement. ffor air is
heavy, & would fall flatt, If ye action of flu=
idity did Not sustein it. And there is Great

reason

22. Resolves.

reason to thinck, y^e^ air is made up of the
materiall about the surface of y^e^ Earth, Ex=
=haled, or made air, by y^e^ vertue of heat, and
so by heat kept in y^e^ State it is. ffor If wee Con[=?]
sider how Much of that Surface is mere Wa=
ter, or watery, that is wett, compared with
the Dry; and how much Easier water turne[s?]
Into air, then any other Non-fluid Substance,
(for /meer\ warmth doth one, but a strong Culinary
fire is Required to Effect y^e^ other) Wee May
justly Conclude a Majori /(exquo denominatio fit)\[385] that
the air Con=
sists of Evaporated water.

The moderne o=
pinion, that air
is somewhat spe=
cifick, & not consti=
tuted of any other
sort of materiall..

I know well the latter vertuosi have Come
to a Resolve, that air is of a substance spe=
cifick, as, water, mercury, oyle, &c. /w^ch^\ are not
made up one of the other; so they say that
air is as distinct In its nature as any other /thin[g?]\
and hath that compressible & elastick Qua[=?]
lity, so well knowne. but wee are are Not oblidge[d?]
by authority's, ut /non\ libere philosofemur^ae^.[386] I am
of a contrary opinion, and esteem that /to be\ one
of y^e^ subterfuges this age bears; when men
can say, air is somewhat /but onely!\like /to\ it self, ~~but~~
/but\

They say Not what
air is, & so Say
Nothing.

hath /give\ No Caracter of any Essence /as to say of what
sort it is And.\, ~~but is~~ des=
cribe~~d~~ /it onely\ by Quality's. as If of body one should
say

[385] i.e., 'the majority of what is called' (air) is ...

[386] i.e., 'and not free to philosophise'.

it is a thing capable of colour, or sound; Not much would be understood by it. So of a Spring, that it is a thing, w^ch^ being put out of place, will Returne to it againe. that Such Consequences are true, who doubdt's? but What is understood by it? ~~And so~~ /thus\ all philosofy is dissolved Into Quality's, becoming a science of words, and not of thing's. Against w^ch^ I have sayd Enough, and shewed how necessa= ry it is to assigne to all body's y^e^ Same Essence, & draw their quality's from Modes, & necessary consequences of that Essence.

The Notion of vapours in y^e^ air as distinct from y^e^ ayrs body a figment.

But this singular air is allow'd to suck up and to containe much water In its bo= dy, by way of vapour; And those vapours are supposed to Reside in it, as different ffrom y^e^ air as water is from a spring. And according as these vapours, by I know Nor What Caus, chance to huddle here, & there, so wett appear's In y^e^ air. And they allow also, that cold comands these va= pours out, In y^e^ forme of water, & heat bids them fast. The cheif proof that is alledged ffor this, is that by force of cold they can defecate y^e^ air of all vapour

or

~~of~~ or water, so as by No Mean's any
more shall be drawne from it, & It Shall
Remaine pure air, without any vapour
Air cannot be at all. Against this I alledg that all air
defecate of water hath in it self that w^ch will become wa[=?]
but to a degree. ter, & that also w^ch will never be water,
but is perfectly dry. ffor there is raised
from y^e Surface of y^e water, In dust &
Smoak much materiall y^t is properly dry
And probably, water it Self, by being
part of y^e air is broken & rarefyed, may become also dry,
dry, w^ch may or assimilate with that w^ch is dry, as
assimilate or when powered upon lime, and be No More
hold fast some capable (ordinarily) to Returne to the
water, as lime &c^a. forme of water againe. but yet I must
account the Greater part of y^e air to be
meer water, and capable to become such
by coalition of parts, And cannot agree
that it is possible, by any mean's practica[=?]
ble to purg air of all watery parts.

of the raising wa= And as to that, wee must consider, wha[t?]
ter by fire, Some Render's a body from solid or settled, to
by alternate take y^e forme of a/n aeriall\ fluid? Motion. then, y^e
rarefaction & Contrary of that, rest; must /if anything\ Reduce /such\
Condensation of ffluid
water. to be setled againe. It is easy to prove
the

the fformer, by y^e^ force of fire, of w^ch^ the
late Invented Engin, for raising water
by fire,[387] is a clear Instance. for there Water
is raised In Steam by a strong heat and
that steam conducted Into a vessell full
of water, with a vent contrived aloft
Enters with such force as shall croud out
y^e^ water to any height, or burst y^e^ vessell.
And then, when y^e^ steam, that is air from
water, hath filled y^e^ vessell, cold /water\ super=
Induced upon it, /cools y^e^ vessel [& so?]\ Makes y^e^ new made
air
shrink & Relaps Into water, & consequent=
ly (proper valves being disposed for the
porpose) y^e^ vessell Suck's it self full of
water againe; & so by two vessell's wor=
king alternately, a continuall Current
is maintained at y^e^ vent. Here it is plain
that y^e^ agitation of y^e^ water, turnes it
Gradually Into Air, that is, raiseth it in
Steam, w^ch^ they Call boyling-away. And
cold shrink's it back into Water, w^ch^ is
by causing y^e^ motion to ceas, w^ch^ Comes
to what I affirmed that the difference
between an aeriall fluid and a setled
fluid, is onely In degree of motion, y^e^ one
clashing & Interfering, & y^e^ other Conti=
guous &

[387] RN is describing the 'Fire Engine' patented in 1698 by Thomas Savery (1650-1715). Savery's engine was demonstrated to the Royal Society in 1699 (*see* the *Phil. Trans.* 1 January 1699 vol. 21 no. 248-259 228 (http://rstl.royalsocietypublishing.org/content/21/248-259/228.full.pdf+html). The Fire Engine not only inaugurated the mechanical application of Boyle's law for productive purposes (i.e.,'raising water', pumping mines), but also resulted in the changing of the length of time offered by patent protection when the so-called 'Fire Engine Act' was passed in 1699, extending patent protection from 14 to 35 years. The result of the act meant that anyone wishing to develop steam power had to do so in partnership with Savery. Thomas Newcomen (1664-1729) developed the first 'proper' steam engine in partnership with Savery in 1712, and in 1715 the two men established a company to exploit their patent: The Proprietors of the Invention of the Raising of Water by Fire. This combination of scientific and legal power shaped the first quarter century of the Steam Age. This 'new technology' is readily and seamlessly assimilated into RN's physics - so much so as to serve as a demonstration of it.

& Sliding, or so as the one hath a great proportion of subtiler matter Mixt with it and y^e^ other but litle; w^ch^ con= dition of matter once conceived, It will Not be difficult to Imagin, how there is No Medium between those two States, but It must be one or other determined. & one Cannot pass to y^e^ other by Swelling degrees, but all at once. as the parts of water must be Either steam or water, and If y^e^ whole body of water goes off at once It is an Explosion of great violence Such vast space doth y^e^ matter of water Require to Move in when put Into y^e^ forme of air, that is, Intermixt with so Much of subtiler Matter. Now they tell us, that this engin is a proof, that onely vapour from water, will Returne to water, and y^t^ air in generall yeilds little water; ffor If they let In fresh air, & cool y^e^ Vessell It will Not suck it self neer /so\ full of water, as when filled with steam; for then upon application of y^e^ cold y^e^ Steam goes back Into water w^ch^, air Will Not Neer doe. And they Could Not Make an Engin work So with meer air, without steam of water

No Medium be= tween the 2 States of fluids, aeriall & setled, ffor Eve= ry one, is either that or this.

Here

Resolves, ~~52~~ ~~27~~.

But Some air is neerer Retur= ning to Water then other, as misty air hath a quicker pass then dry air.

Here are Many Considerations offering. first I doe find plainely, that tho there be Not degrees between water & air. yet In the convertibility from, ~~water to~~ air to water there are degrees. ffor the new raised steam or vapour, will sooner, & with less cold, Returne to water, then Comon air. for w^{ch} divers Reason's may be given, and not oppugning our theory of y^{e} air. ffor the steam is less dispers't, and Intermixt with other air, w^{ch} wee suppose, by y^{e} agitation is become of an uniforme Composition, & so hath many dry part's Intermixt with ye Wett, that may make a greater force Required to subduct y^{e} wett from them, then from a vapour or steam, before y^{e} agitation hath wrought that mixture, as afterwards it doth; And In y^{e} Engin-vessell, there is Nothing but Steam, Not so broken and Intermixt as without, y^{e} water & /dryer\ air are. So No wonder that subsides more then Com= mon air will. Then the force of y^{e} Cold cannot operate upon comon air, as upon steam, becaus as to that, it is More violent as the tempers are distant. ffor the steam being hot is all one as If y^{e} /cool\ water were

so

so Much colder. ffor I observed ye Steam
made ye vessell hot, past all touch. then
came ye cold with a strong Effect of Contra=
riety. Now If air were made hott, and let
Into a vessell to be suddenly Cooled, there
is No doubdt but It would shrink more
and yeild more water, then ye ordinary air
lett in will. Another thing to be Considered
is; that water may subsist In air, & hold
the forme of water, but In very Minute
dropps, wch not Sinking, (for reason's already
Given, & to be hereafter rem'bred) May Come
so close together, as to obstruct the direct
passage of light, as clouds doe. or It May
be so broken & dispers't, as Not sensibly
to disturbe at all ye Cours of light, as In our
ordinary clear weather. And It is observed
that when air passith Into ye forme of wa=
ter it is first discerned by small dropps or
mist, wch by coalition Grow Greater, & then
by force of Gravity, come to flow. Now It May
be that vapour is In greater drops, or
readyer to flux, then water, /ordinarily is\ In ye Comon
air,
wch If Not assimilated or become dry, have
more degrees, or Coalitions to pass, before it
comes to be sensible water, and yet both
one

Air turnes Into water by many coalition's of dropps, before it is sensible.

one other are of the same nature, that is
watery air. If it be asked, Why water so
In y^e^ forme of air, doth Not according to its
nature of running together, Imediatley Coal=
lesce, & become water. I answer the Comon
agitation of the whole; that w^ch^ Made wa=
ter become air keeps it so. Whither the Wa=
ter In y^e^ air have any other shape, or Con=
dition then as dropps, however small is
more then can be determined; what wee
discerne is dropps, but then it May be sayd
to be Returned to water, but too Small to
subside. or how it is that water Evapor=
rated, Requires so much more room, wee
cannot minutely discover, No More then
other minute or Elementary part's of Com=
pound matter. therefore wee must look
upon y^e^ Gross & complex Effects as symptomes,
and thereby conclude, that /from\ y^e^ plenty and
Ready passage of water Into air, /that Water\ must
Constitute the main body of it, however
More or less difficult to comand back again.
I shall conclude this paragraffs with this
observation. that wee have much more
Comand of heat then we have of cold,

There is Much more comand of heat then of Cold.

for

30. Resolves

ffor wee can Carry y^e^ latter No farther then
nitre & salt will operate, w^ch^ will Make
water become Ice; but Not shrink air be=
yond a certein degree; As for Instance If a
*q^u388^* florence flask were luted hermetically, &
cooled, y^e^ air would Not shrink so Much as
to have y^e^ weight of y^e^ air-Sphear burst it,
but a much stronger vessell may be burst by
heating y^e^ air within it. And that May be
raised to almost any degree of force, as
furnaces may be contrived, and Materialls
made. but Cold will not goe beyond the
Endurance of our tender flesh, w^ch^ heat
will readily tear all to peices. therefore
And when y^e^ It is No wonder, that y^e^ vertuosi p^r^tend to
cold Cannot be purg /air\ of all its water. ffor when they are at
made more In= an End of their cold, they say y^e^ air is purged
tens, then they say but how appears it, but If yet Stronger
Air is wholly cold were brought, y^e^ air would Not yeild
purged from Water. yet more water? therefore I adhere to My
Evaporated Water; Such as heat hath
raised & converted Into air, and that Cold
will In great Measure Rreduce to water
againe, the ordinary Effects of rarefaction /& condensation
\
that is, swelling & shrinking Constantly atten=
ding y^e^ operation's.

---

388 '*q^u^*' in the same ink as the main text.

The alteration's to w^ch^ air is ob= noxious.

Having belaboured this Matter Enoug, I proceed to Consider the air In generall, as y^e^ Globe of Earth is Invested with it, and the seve= rall accident's it is lyable to. first that it

1. heat & Cold & y^e^ Consequences.

is obnoxious to alteration's of heat, and Cold, and that In all degrees, within almost y^e^ toleration of humane nature or animall life; ffor No air is so hot or so cold, but Animalls of some sort or other, If not hu= man kind live & breath In it. but all pla= ces upon Earth are obnoxious to alteration's some hotter & others cooler then the or= dinary temper of the place. It is the sun

Heat is from y^e^ Sun but Not according to de= grees of proximity but combustibi= lity of matter, & Reflections of light

that Regulates y^e^ warmth about y^e^ Earth. not so much by Immediate Influence, as by the Constitution of y^e^ materialls, and cir= cumstances of place. ffor as some bodys are combustible & others not, or at least Not without a stronger fire. so some places have a materiall, w^ch^ will warm with less heat then others. And If wee goe from this condi= tion up into y^e^ aire, wee shall find a Win= ter Cold, In summer; what is it then In y^e^ Ether above y^e^ air sphear. therefore those Err who Compute y^e^ Efficacy of the suns

heat

heat by distance. Then valley's have More heat from Reflection, then hills. And the southerne part's of ye Northern & North part's of ye Southerne, have more heat then Either way without ye tropicks; ffor the sun works dayly alike, or with small difference, & keeps ye earth hott. And for the Same reason, In ye obliq hemisphears the sun's heat seem's stronger, In ye Same altitude then at a winter meridian. be= caus a long Continuance above ye horison hath heated ye Earth & air, wch doth Not cool On a sudden, and then ye Sun is Mor[e?] felt. but In such places, ye sun generally being low, makes much shade, by ye litle asperity's & protruberances of ye soyle, and doth Not touch half of it with a clear ligh[t?] as when it Mounts towards the zenith; this is that they call a direct ray, wch hath force from that reason. but yet In ye Northern part's where ye sun is neer simestrall the Continuance above ye horizon, Not= withstanding these disadvantages & others, as passing thro a thicker or more of ye air, by reason of ye obliquity, makes an hot

Reason's of diffe= rent heat accor= ding to climates.

hot time, and Ripen's fruits, sometimes so as to have 2. Cropps In a summer; and were Not y^e^ winter so desperate, would make us kindly an air for all sorts of animalls & plants, as any upon Earth.

The air about y^e^ Earth, Would Not be in any level If gravity did Not Reduce it, as ~~wh~~ water when Rarefaction or condensation makes Inequalitys.

Therefore In the generall the Artick & antartick air, is to be accounted Cool and the Equatorian air warm. And the ordinary dilation and Contraction of one and other, to be accordingly. ffor w^ch^ Reason wee must conclude that If y^e^ air of y^e^ whole Earth were made of a temper and let goe, to the disposall of accidents according to the Scituation; the air about the Equator would swell, and that about the articks Shrink, and y^e^ whole make a flatt forme, rather then Exactly round. But then wee must also Imagin that the force of Gravity would Carry that w^ch^ is a= bove y^e^ levell Into those parts w^ch^ are lower, And there with y^e^ Rest come to like conden= Sation. so that In y^e^ whole the air of y^e^ articks is More Condens't, and so a Colume there is really of more content & heavyer

polar air More condens't, & that swells If sent towards y^e^ tropiks & tropick air shrinks, sent tow= ards y^e^ poles

then

then a like Columne at the Equator. Now
If any accident bring's artick air towards
y^e^ Equator, or y^e^ Contrary. It must swell
or shrink accordingly. And If it swells, be=
fore it can dispers into a levell, it will
be Gibbous In the surface of y^e^ air Sphear
and /if\ shrinking concave or as a valley,
and those Inequality's Rest Not, untill they
as water, & its waves, setle Into a levell.

The Nature and consequence of winds.

Nothing ~~can Introduce~~ /! is more odd then that\ such translation
or Current of air, ~~but~~ /however beginning yet Introduce one
& other, & are\ ~~t~~What wee Call Winds
but air In a body Moving; and It must
needs carry with it y^e^ temperature of the
place from whence it, comes and Receive
alteration according as y^e^ temperature
is w^ch^ ~~e~~Enterteins it. This Theory of y^e^ Winds
is a subject for a just treatis, and Needs

experiments are much wanted ,

a naturall history of Experiments, and
to be made all y^e^ world over, as well as also
a carefull sagacious application of them, &
after all, litle enough to Instruct us In a
subject of that Infinite variety & accident
as y^e^ winds have. yet the ~~subject~~ /matter\ In hand,
y^e^ baroscop, is so tyed to it, that Wee Must
with

with that Information and skill wee have, pro=
ceed & make y^e^ best Eclarissement wee can
of it. Therefore first I charg the generall or
primary Caus of winds to Rarefaction and
Condensation. There are Currents In the sea,
w^ch^ is not rarifiable Nor condensible, while
water. but for them, there are other reasons
/w^ch^\ wee ~~doe Not~~ know /doe not\ belong to y^e^ air, as Winds
both ordinary & Extraordinary, ~~as~~ Hurricanes
spouts, tornades & y^e^ like, so also that w^ch^
is y^e^ Caus of tides. But In y^e^ air heat & cold
Makes Strang alterations, as have bin touched.
If the alteration's So made, were confined
to y^e^ place where y^e^ caus Resides, It would
take away much variety; but If once a
chang happens, whereby the surface of the
air sphear is raised, or depressed. there
follows Instantly a current of air Either
to, or from that place, and Most that way
as y^e^ air may Easyest pass; and that current
augmented (and Eo Nomine[389] winds,) needs
litle Reflection to Imagin. as ffirst a current
straitned, w^ch^ In y^e^ air May happen, by
mountaines, valley's straits, and so also
by clouds and /Even\ other currents as May happen
therefore

The caus of Winds Referred to Rarefaction & condensation

The Inforcing of Winds or Storm.

[389] i.e., 'by that name'.

therefore it is Not Strang, that winds ffrom
very first faint beginnings may contract great
force, and be what they Call storme. Winds
may farther be originally Made by ye Weight
Weight of ye of clouds, ffor when a whole Country is Cove=
clouds Conduce red with an Immen's flat cloud, It Must
to wind In some Measure, drive air from under it
wch will take ye Easyest Cours, and that or=
dinarily is by /Joyning with or\ augmenting such wind as is
Trade winds stirring. The trade winds are originally Made
rarefye before by the sun passing & rarefying ye air a=
ye Sun fore it. this is about ye Equator & ye tropicks.
But neer lands ye trade winds are bent or
diverted; and at ye Edges of ye trade winds
there must be eddy's, wch may fall In con=
Juncture with other casuall winds, and so
How changes break thro ye trade winds such are ye tor=
& [rages?] may nadoes. &c. And such contrariety's may hap=
happen. pen, that winds are from all part's, that
is rowling about, like whirelpools, and
seem to drive from all points of the Com=
pass, Successively. So accidents In some places
are the occasion of accidents In others, &
accidents Create so many upon ye whole Surface of ye Earth are
accidents, & ye continually at work, that the whole
surface of ye Globe is surrounded with them. In some
Earth, obnoxious places there are more regularity of Winds
to 'em. then

then in others, and oftener Chang, w^ch^ is
observed of Islands and marine scituations.
some winds Reigne about certein seasons
Monson's are as In England, East & North In y^e^ Spring,
derived from much to y^e^ p^r^judice of fruits; and south &
y^e^ trade winds. west in autumne; In y^e^ Indies there are
semestrall winds they Call Monson's, All w^ch^
In y^e^ Maine are derived from y^e^ cours of
y^e^ trade winds; but yet far from certeinty
as to beginning Ending or Continuance.
And to lay downe Rules about y^e^ winds one=
ly In such latitude, as when wee say for
y^e^ Most part, ordinarily, or about & y^e^ like.
is an undertaking to make a scale of
Innumerable accidents begitting one and
other; therefore I leave this discours of the
origination, & cours of y^e^ winds, having done
In ~~it~~ it Enough for my porpose. and Repair
to y^e^ Consequences of them, w^ch^ will come
neerer to my buissness; ffor If I have It Gran=
ted that there are severall currents of air
upon or neer y^e^ Surface of y^e^ Earth, In various
directions, I may proceed, and Reserve divers
Remarks In particular, to such places, where
the occasion will call for them to be ob=
ser<u>ved.</u>

38. Resolves.

Chang of Winds is ye Caus of Chang of weather.

The Consequences of ye Chang of winds is In generall chang of ye weather, from Wett to Drye, & 'E Contra. And depends on the Region from whence the winds come, and the air that accidentally is In ye way of them. ffor I find Nothing More sure then that while a wind blows steddily from one point, whither hot, or Cold, ye weather is Drye. And It seldome or Never happen's, but If wett gather's, ye wind changeth, or rather The chang of ye Wind, tho our obser= vation hath it Not so soon, hath changed the weather. ffor it is a different tempe= rature of air Interfering & Mixing, wch creates wett. that Is If either a Cold Wind comes against a warme air or a warme

contrariety of temperature In ye air Interfering is ye Sole caus of wett, rain &c. and thunder is when most sud= den & extreem.

wind upon a Cool air, /so If ye Earth be cool, & ye air warme or E contra\ then are clouds & rain generated. And according to this It May be observed, that one wind Shall be aloft & another alow, as ye rack of ye clouds de= monstrate, and In that Case If there be any great Contrariety, rain is In ye Sequel. When opposite winds are striving Inde= termined, If the contrariety of them be Much, then follow Thunder & lightning, and usu= ally, as ye [Daye?] Requires it is calme weather

there

There clouds generate, and are by y^e^ oppo=
site winds crowded together, 'till wett occur=
ring with aeriall Combustibles, caus accession
with a frager, that eccoing between y^e^ Earth
& clouds is so terrible. And divers whirling's
unaccountable will happen, as an Easy
view will discover, and winds will Come by
Gusts, and If any be very Incertein. As wee
have divers turnings and whirlepools of
wind among Great hill's & valley's. w^ch^ y^e^
How laplanders cheat by Selling winds.
laplanders knowing, can direct saylors to
points where they shall Meet a desired
wind, and they call it ~~buing~~ buying a
wind, beleeving y^e^ people are witches and Can
sell it. so among the clouds are divers tur=
ning's & winding's of the air, w^ch^ have Consi=
derable Effects, where they are, tho Not well
discerned by us. for Instance, the Aprill showrs
have often a strong wind attend y^e^ cloud
from whence they fall, as If y^e^ cloud made y^e^
wind & Not y^e^ wind y^e^ Cloud. ffor Where a tur=
bo of wind it, It can scarce be without [shou=?]
ring Continually.

It must Not seem strang that I charg all
wett in y^e^ air, from contermination of heat
and cold. ffor I thinck it is to be demonstra=
ted by Induction of all such conjunctures

40. Resolves.

All the confini= a of heat & cold are wett, proved by, climes, sea- sons &c[a].

As ffor example, It is y[e] midle climates that Most Incline to wett, ffor both In y[e] Extream heat & Extream cold, the weather is more dry, and Wett but at certein season's in y[e] year. 2. those sea= sons In y[e] cold climates, are In the Interim between sumer And winter. ffor at a certein time, when y[e] great frosts are Entring they are fore run by vast flights of snow, and those /continue\ upon y[e] Earth ~~is sealed up~~ with clear weather till y[e] Sun begin's to advance, & then y[e] Snows Melt and the Rain's fall. In asia the rain's come also spring and fall, y[e] Rest of y[e] year is Dry, these are Called y[e] former & y[e] latter raines. Between y[e] tropicks, rain usually follows y[e] sun ffor under y[e] northern tropick, It is Sum= mer, when y[e] Sun is at y[e] southern tropick, then is all y[e] winter they know, w[ch] is rainy

And In our tem= perate sphear, y[e] raines come about Spring, and fall, in Greatest proportion then at other times as If, y[e] year were devided by a watery bounds to distinguish sumer & winter.

tornados, hurricanes, & stormes. whereof I take y[e] reason to be that y[e] nights are /then\ longer and so y[e] cold gets strength against the sun comes with an Intens heat, whereby y[e] contrariety is Greater, then when y[e] days are longer, & y[e] Sun more moderat & y[e] Night's short, & having somewhat of crepusculum. 3. The region's of y[e] air between the Cold of the parts /farr\ distant from y[e] Earth, and the warmth about y[e] surface of it, is most

charged

charged with wett, for there is y^e^ Resident's
of clouds. 4. the time of y^e^ day, betwixt e=
Instances of Wett vening and Night, and betwixt Night &
generated by y^e^ morn', cast most dews. And If wee Condiscend
air, princi= to lesser Experiments, they are very Evin=
pally by distilla= cing. as a Glass Cooled with wine, gather's
tion. wett from y^e^ air that is Warmer against it.
And the Grand Experiment of all is ~~a~~ /y^e^ art of\ distil=
lation already touched; ffor as the contrariety
is increased by Cooling y^e^ Still head, y^e^ vapour
yeilds more liquor. I may Remember that
of y^e^ florence Flask; with a barometer Erected
in it. but so many and so constant are
these proofs of so plain a truth It is fastidious
to dwell longer upon them. From Hence it
may be Noted, how wide from any porpose
it is, to talke, as most doe, as to clouds & rain,
of vapours here & there, where all y^e^ air is
Ice, often binds vapoured alike, and when cold comes failes
y^e^ wett up from not to Render its water; unless it be so In=
falling, tho con= tens as to bind up all In Ice.
densed Into dropps.

The degrees by w^ch^ water breeds In the air
are to be observed. The first formation of
The manner of humidity, is by dropps so small, that they
wett breeding doe Not onely hang in y^e^ air, but scarce ~~hind~~
In y^e^ air. disturb y^e^ passage of light. but yet body's y^t^
have y^e^ propertyy of Spunges shall Reciev this
moisture

The caus of Thermometry.

moisture, and by flaccidity discover it, before any signe appears to ye Eye. upon this are grounded those many thermometers or hydroscopes that folks use, ~~as~~ /for\ prognosticks of chang of weather; as snakes skin's, pictures In oyle, or prints upon cloth vernish't, Gut strings, twisted cords & ye like. but these fail as often as ye Moisture is but dew, & Not ge= nerall. ffor they Shew onely that the air of ye place where they are is Moist. The Next

Then Mists ap= pear, & such are ye Clouds.

Step is mist, or wch is ye Same thing, clouds. ffor clouds are but heaps of Mist carryed away with ye Wind; and comon Mist is when the cloud Rests upon ye Earth, and wee are in it. This is when the small drops by Increasing, have

The air amon= gst ye misty drops of a cloud, make one mass with ye mist, and are driven together.

come to a Coalesence of divers together, by wch they are larg to a degree ~~of~~ able to Inter[=?] cept ye ray's of light, and so deprive us of the clear light of ye sun, affording us onely a secondary light that comes with Many Re= flection's thro ye clouds. these tho larger do not yet fall, but defend agt ye wind passing thro them, as well as break the direct cours of ye Sun's light. ffor when ye air Moves, ye Cloud[s?] with all ye Intersperst air Goe together as one Intire body, and so ye whole is conveyed from one place to another; Sometimes one

may

Resolves ~~60~~ ~~43~~

May see Manifestly, clouds grow In y^e^ air, ~~or~~
from Nothing, as it were, or being formed shall
Increas, w^ch^ is a signe of wett approaching,
and y^e^ Contrary, when y^e^ clouds are observed
The Magnitude of dropps capa= bo of falling thro y^e^ air. to wast. The degree of magnitude to w^ch^ drops must grow by coalescence before ~~y~~^e^ /they\ fall, must be such, as that y^e^ solidity, or substance, w^ch^ is y^e^ force Gravity work's with, is More then Equall to the Resistance, w^ch^ is according to the proportion of Superficies; As I Shewed be= fore; for till then y^e^ Resistance by vertue of y^e^ superficies, is more then y^e^ Gravity by means of y^e^ content or substance. The autumnall dews are Remarkable, ffor thy begin about Sun setting, in the lower places, where the last warmth of y^e^ Sun had Evaporated some moisture, And then a Cool air Enters, and mistiness grows visibly, ffor y^e^ air neerest y^e^ Earth, & y^e^ Moister parts of it, is as steam, more ready to render, then air that hath bin longer in that forme. In y^e^ Morning y^e^ valley's shall be Covered, but hills will often, tho Not allwais surmount y^e^ mist. And it
Mists Retein a levell. is observable, that y^e^ Mists will Retein their level as water, so that y^e^ valley's shall appear like sea _ & y^e^ hills like Islands.

when

Note
ye caus of ye level
is the air with ye
mist is a difforme
fluid, as to weight

44. Resolve

when ye Sun Gathers Strength, Sometimes
a wind takes' ye Mist up, & convey's it away
In ye forme of clouds, and sometimes it all
Gathers Into larger dropps & falls downe.
When by advantage of ye Sun's light one
may discerne, the very litle dropps moving
unaccountably to & fro, but declining, &
so often before ye Mist is is departed ye drops
will be Neer as rain. And that wch is very
remarkable & pleasant to observe is a
whitish rainbow, will very Eminently shew
it self In ye Mist.

Mist aloft, yt is
clouds more a
signe of wett
then mist's below.

When ye Mist is below, and it dry's aloft
it is a signe of fair weather, but If it dry's
below, and Mists aloft, It is a signe of wett
wch ye Inhabitants of mountainous Coun=
try's will observe by ye hanging of clouds at
the tops of ye hills, & thence prognosticate wett.
The reason is, when ye Mist grows onely below
It is for a slight and particular Caus, the
Imediate air Next ye Earth, without Much
If any wind. but If it wetts aloft, It Must be
from some distempered wind, that Mixeth

Mist's frozen Can=
not coalesce.

In ye air, & produceth clouds. A Mist May be
Either water, or Ice; and ye clouds at their
height are usually such, wch is ye reason
they doe Not allwais raine, for Ice will
touch

The reason of Rine & snow.

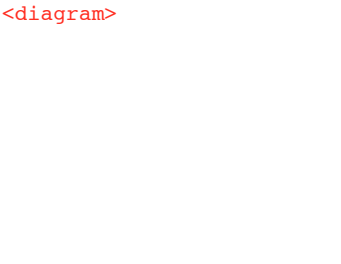
touch & Not coalesce, but when an adven=
titious warmth thaws them, then they run
together & fall In Raine. When y^e^ Mists
below are in Ice, & so stick to trees, and wals
In white thredds, wee Call it Rine; And it
is Not without some degree of moisture, ~~w^eh^~~
that they doe so Cohere, and however it
is In the air, neer y^e^ Earth there seldome
wants warmth Enough for that. when y^e^
air Renders moisture very fast, and there is
an half frost, or so much as turnes y^e^ Minute
dropps to ice, and yet some Remaine Not
frozen, those are amongst y^e^ other and
make them In some degree wett, and conse=
quently sticking together; then It falls in
fleaks of icy /dropps\, w^ch^ wee Call snow, w^ch^ is but
misty dropps frozen, and some In water w^ch^
humeatates y^e^ Rest, Els, as If y^e^ frost /were\ very In-
tens, they would Remaine In mist or Rine.
but so they Gather one to another and
small fleaks by touch cohere to others, &
make larger. When frost is Intens y^e^ Weather
is comonly clear, and If a warme wind
comes, It brings snow, and perhaps a thaw
but If the cold winds p^r^vaile, then the Snow
ly's. it is very remarkable that when frost's
are Intens, and there appear's a disposition
to

46. Resolves

The reason of the Hexangular Starr's observed in snowy wether to fall

to Snow, but litle of it comes, onely small fleaks and rare. then If some new fallen be observed, It shall be found as hexan= -gular starrs; or, as some Resemble them, spurr-rowells, wonderfull thin and shining but otherwise spread Enough. the points are allwais. 6. and as those are derived from y^e comon center, so others derive out of y^e Edges of them, all alike in Exact uni= formity,and yet this is y^e product of chanc[e?] But the wonder may ceas, when it is Con[=?] siderered that they are all Compose of Globu[=?] les of Ice, very Small, & Gathered by a Swift motion, such as breezes aloft In y^e air excit[e?] first for y^e flattness. If there be at y^e first u= nion of a few parts, any side broader then y^e other, the motion will Not be that way for the Impediment, but rather to turne when so y^e Impediment is litle. As If one takes up any thing light & broad, as a feather, it is not easy to move it by y^e flatt, and striving to doe so it runns edg[=?] wise, of it self; so those beginnings thus turning on-edg. nothing gather's ag^t y^e flat but y^e edg Gathers very fast, & so Mo= ving one way other the Gatherings Na= turally as Globes fall into y^t hexangular

forme



forme. as here, 6, Globes with one between
as a center touch, and put a Globe In
Each Juncture (or spondrill) without, as
of it self it is most apt to fall in & lodg
and you have y^e^ foundation of y^e^ Hexan=
gular starr. W^ch^ forme must goe on and
appear In all Gatherings whatever by
the Edg, and so are like teeth, or sub points
coming out of y^e^ other maine ones, and all=
together make a pretty uniforme figure.

The Reason of Hail

If the gathering's are very fast and y^e^
winds Impetuous, the mass collected is
driven close, and having moisture with
it, coheres in litle pellets wee call hail;
w^ch^ happen ordinarily In sumer storms
as well as In winter, but More Impetuously
by reason of the fury of winds among the
clouds, w^ch^ raiseth Such Extraordinary dis=
orders, and produceth ~~sh~~ such Imens showers
When y^e^ heat is Great, and a Cold comes
over it in y^e^ air, the contrariety is More
then In In Winter, When all is cool, and
a litle more or less makes the alterations,
And opposite winds doe Not happen In
winter, When so Many winds are stirring
as determines them clearly one way

or

But In sumer, Calmes will happen, &
winds are often very broad, and Ma[y?]
be In Every Respect Contrariant, & de=
termine slowly, In y^e^ Mean time is that
The reason of Thunder & Stor=mes. grouth of clouds and protruding them
one against another, In vast heaps &
volumes, still breeding various Gusts of
wind there; and spirituous exhalations
or of matter being in a Sulfureous air
gather, & accend, whence wee have the
terrible phenomena of stormes, hail
Gust's of wind, & calmes alternately, dis[=?]
mall clouds, and Strangely rolling about
with such fire & fragor, as amazeth us
litle things that can but fear & wonder
at them. These matters, becaus our subject
is y^e^ weather, and its prognosticks, I thought
ffitt to touch upon; And If I could have made a
more perfect Idea of y^e^ air & its meteors, it
had Not bin superfluous or out of y^e^ Scope of
my designe, in Explaining y^e^ reason and
use of the Baroscope.

Then to Come neerer the application, I
must consider how y^e^ spring of the air is
affected, by weather, and the beginnings
of changes of it. It is comonly sayd that
when

Resolves ~~63~~ ~~49~~.

An Error to Charg more specifick weight in ye air for ye high Standing of ye Mercury.

when the Mercury stands high, the air is heavyer, then when it stands low. and they conceiv that the alteration of ye air from the state of wett, to that of drought make's it ~~lighter~~, heavyer, and ye Contra= ry, lighter. ffor it is observed that gene= rally when wett is ~~Growig~~ Growing, ye Mer= cury falls, and upon drought riseth. this is

but rather ye air is lighter, at high mercury, becaus dryer, or More rarefyed

Contrary to reason. ffor If a Cubick ffoot of air is taken Impregnate with moisture, and another perfectly dry, It will be found that the moisture is ye heavyer, ffor there is More of ye Materiall of air in that, then in ye o= ther, wch is more rarefyed; and then It

Note.
In frosty weather ye air may be full of moisture, & No mist appear.

seem's as If, upon wett, ye Mercury Should rise, but that is generally otherwise. perhaps they may say that moisture in ye air abates the spring of it, and so makes it yeild to the mercury. but that will Not doe, Neither ffor the air hath No less spring ffor dropss of water scattered in it. If a room be full

drops doe Not weaken ye Spring of ye air.

of smoak, the air hath No less Spring, becaus it is crow/d\ed from ye air abroad; so long as the weight is upon ye air, wch is not less for any wett in it, It will keep its spring; so These suppositions doe not square with the state of ye baroscope, & the variátions of it.

wee must therefore look out, ffor some
other Caus of the air abating & Invigo=
True caus of ye rating its spring. then wee will Imagin
mercuriall Sta= the air in ye Comon state of fluids, and
tion & changes that all ye Rules of Hydrostaticks take
from height of place in it. And consequently, that a
ye air sphear body is pres't according as the Immer=
In perpendiculo. sion is more or less, ad perpendiculum,[390]
as hath bin Shewed. and then that the
raising the fluid, is equivalent to the
depressing the body. as for Instance a
body is Immers't in a fluid, 10. foot deep.
If you pour in Enough to rais ye Surface
a foot, or, as it is, depress ye body a foot,
that body hath exactly the Same pressure.
And then all rising and falling of the
surface, charges or Releives ye pressure
below accordingly. So that If a baroscope
were Erected under water, lading out ye
water, would lett downe ye Mercury, and
filling in rais it. The like I Imagin In
The Consequences the air, If it happen's that the Surface
of humidity In of ye air-sphear exalts, ye mercury Must ris[e?]
ye air, so slight and If it sinks, It muat fall. And the having
to have No place in More or less moisture, is Inconsiderable
In ye accº of ye however somewhat it May be to affect
Baroscope. in the
ye open air.

[390] i.e., 'in the vertical'.

Resolves ~~64~~ ~~59~~

/the air\ But that somewhat, whatever it is. ac=
ting contrary to the cours of y^e^ Instrument,
that is to deminish its variations In y^e^ Way
Regarded ffor prognostick of chang; wee can
but lay it aside, as of No vallue to have
any Notice In the Resolution of y^e^ baroscope.

cold Makes y^e^
air subside &
heat, swell; &
that is governed
by y^e^ North & South
winds.

Then wee Must resume what was Noted
that as soon as Either warm air comes
over cold, or that over warm, wett will In=
gender In y^e^ air. but generally the wett
is from the aggression of y^e^ cold; ffor It is
that w^ch^ abates fluidity In y^e^ air, & dispo=
sith it to Render Moisture. And wee know
that Cold air Comes from y^e^ North & east
parts, and y^e^ warm from y^e^ South & west,
but since It is onely Cool & warm that
distinguisheth wee shall use for correspon=
dent descriptions, the North & South, but
meaning in other degrees within such
latitude upon y^e^ face of y^e^ Globe. then it
is true also, that When y^e^ northerne air
Comes Into southerne climates, It must
Swell, and when y^e^ southerne comes Into
northerne climates It Must shrink, and
It is the Respective correspondent winds
that are

that are Efficient of these alterations;
as when the North wind blows, y^e^ air Swells
and when y^e^ South blows, It shrinks. It will
follow also that this shrinking & Swelling
of the air, must caus a depression or Ele=
vation at y^e^ Surface of y^e^ air sphear. ffor
If y^e^ air be rarefyed, It cannot /sudenly\ Expand
laterally becaus there it is Comprest full, /and much
matter must be driven\ so
It Must rise at y^e^ su'mit where /it is free\ No pressure
is. And If it shrinks, It letts fall that above
it, & so makes a valley. This tumour, &
cavity In y^e^ Surface of y^e^ air sphear, If it
be of any Considerable Extent, Must make
a sensible alteration In y^e^ Mercury; ffor
when y^e^ air is tumefyed, y^e^ Mercury must
rise, becaus the Columne is higher, and
If it subsides, y^e^ Mercury Must fall, becaus y^e^
pressing columne is less in y^e^ perpendicular.
This is mechanicall, and y^e^ true caus of the
In eSome Conjunc= station & alteration of y^e^ Mercury; And how=
tures of y^e^ air ever generally the air shrinks against
y^e^ Indication of wett, whereby y^e^ mercury falls, yet It will
y^e^ Baroscope is not allwais be so; ffor there shall often
confounded. be very wett weather, & y^e^ Mercury rise,
& be considerably high; but this is but In
Some conjunctions of the air, w^ch^ is Not
generall;

Resolves ~~65~~ ~~53~~

Generall, but yet breaks y^e^ rule of the
Indication, and dissappoints the Earnest
observer, and depreciates y^e^ Instrument,
therefore a demonstration, of Such anomala
and Indication when they must be allowed
for, will be of No small service, as to y^e^
use of y^e^ baroscope, & that is much my p^r^sent
designe.

When N. winds p^r^vail, y^e^ Mercury is high in all weather's. con= trary of south, & both have chang by wett & drye In their Compass.

It seems's then, In order to this, that y^e^ Winds
are as carefully to be observed, as y^e^ Mercu=
riall station. ffor If North Winds reigne Wee
must expect an high station, whither Wett
or drye. And y^e^ Contrary of y^e^ South winds. but
In y^e^ compass of Either, there is a proper Ri=
sing and falling, w^ch^ serves for observation.
Therefore I have thought it reasonable In=
stead of one Indicatory scale, of 3. Inches, there
be. 2. /scales or plates\ one on Each side of y^e^ tube, and
of
these one should stand 1/2 higher then y^e^ other,
and be titled N. winds, & y^e^ other S. winds.
And then according as y^e^ winds are, y^e^ Station
may be justly Esteemed. ffor els that w^ch^ is
high under South winds may be low under
y^e^ North. w^ch^ makes a Confusion & distract's
y^e^ observer. but then wee shall be at a loss
againe about y^e^ Winds; ffor I conceive those
are

are Not allwais Natives of those regions
from whence they seem to Come; ffor the
winds may be bent. & diverted from a
strait Cours, by hills, /&\ Islands, but most of
all. from clouds & /also\ other winds. and So What
Comes Courbes, and perhaps vortically from
ye North, seem's to Come from ye South; ffor
wee have No sence to discover whence ye
air comes, and ye weathercocks /are but as a tangent\ shew
onely
ye /strait\ cours at that place. therefore wee Must
Call to aid our Judgment as well as sen-
ses for accounting the temperature of
the winds. and In this disquistion the ba[=?]
rometer it Self is a cheif help. ffirst If
a Cold wind blow's from ye South, wee may
conclude it a Compass wind, and to Come
originally from ye North, so If a warm Wind
come from ye North, wee may conclude it
a south wind diverted; And these crooked
winds, perceivable by ye temper of heat
& cold, allwais declare a disturbed wea=
ther. ffor It is never sereen and. Easy In
ye air, but when ye winds are true & strait.
But the baroscope is ye Greatest Indica=
tion of the sincerity of ye Winds; ffor If a
wind blow from ye south, & ye Baroscope
stands

Impossible direc=
tly to know ye
winds & whence ye
air comes, becaus
ofthen Inflex or
crooked.

The baroscope
best Indicates
the winds, for
high is North
tho, It seems to
come South. [.....?].

Stands high, If it be cool and y^e^ air dis=
turbed with clouds & winds, It is an Infal=
lible signe the true wind is North however
it ~~Comes about~~ /happens to make such a tour\. and In that
case, the Sym=
ptomes Continuing, y^e^ Wind will certeinly
come about and blow from y^e^ North; and
notwithstanding an high mercury, wett may
be Expected to ffollow; And y^e^ ~~alteranate~~ /alternate\ of
all this, (w^ch^ I need Not Rehears,) belong's to the
South, mutatis mutandis.[391]

High & low, or
rising & falling
doth Not Constant=
ly ans^r^ ~~wett &~~ /with\
Dry & Wett. but it
is generally so.

Now as to the baroscope and the use of it
In p^r^dicting changes of weather, there is room
ffor much Judgment & Reflection of the ob=
server, upon this plan I Have unfolded
of the Reason & Government of it. ffor there
is an opinion gone forth, that a low station
foretells wett, and an high, drye weather,
w^ch^ may be generally so, but Not allwais
and the deviation's are very frequent, w^ch^
to those that look no farther, makes them
frett at their dissappointmen^ts^. and Never trust
More; but yet Even those by some other [hitts?]
shall be brought round againe. And really I
have knowne very ffew who once have used
to observe y^e^ weather & y^e^ Mercury however
angry with it sometimes Could Never leav it,
Therefore I shall be glad If My Notion and
application

[391] i.e., 'that changing which needs to be changed'.

application, with what ffollows, will Either
Encourage or assist any, In ye Improving the
use, by strict observing it, and adjusting
some farther rules for ye use of ye Comon peo=
ple, If it may be; In order to Wch. lett us first

direct South is warm, /&\ dry, & yet ye Mercury low.

take the Extream's. A thro blowing south
wind, with a steddy mercury, not very low
is a sure sign of warme weather, and drye
It shall often happen, that In that Case,
there shall be a slow sinking of the Mercury
for Long together, and No signe of wett hath
appeared. but I never knew that happen

ye Caus of falling is Equall in di= vers places, but Shews contingent

but I heard of great & terrible stormes in
other places. ffor the cause of ye /mercuriall\ station is
Equall In all places of our region, but
stormes will be accidentall, and happen
In some places, & Not in others. And I know
no possible mean's to Recover knowledg
of such accidents, but it must pass for one
of the desiderata In ye Instrument. onely
thus farr use may be made; It is certein /In ye case\

a steddy Mer= cury in ye Case dry. fallin In= certein.

while ye Mercury stands. there can be no
wett, and If it Sinks there may, and pro[=?]
bably there will be such, and that it is so
somewhere, may be Concluded. If under a
south wind ye Mercury rise much and persist
as I sayd, ye wind will Come about toward

ye

Resolves. ~~67~~ ~~57~~.

Rising under y^e^ south Winds, is a signe of chang to y^e^ North, or of turbulence in y^e^ air, till it Comes to that.

the North, and so long as it holds off, y^e^ air will Not be Quiet, but it shall be clowdy windy and threatning; ffor it is a rule that seldome failes. If y^e^ Wind be Not as the high or low station Require, y^e^ air is Never Easy. so that many wonder that south winds with a very high mercury, should Not be Wonder= ful clear & fair, when In truth it is a full wind, and derived from some Northern Quar= ter. Another observation is, that If y^e^ fall

Under N. winds a slow fall May be without wett, for y^e^ very chang of y^e^ air doth it.

be very slow, y^e^ wind May chang, or how= Ever it happen's, no great wett follow. but a sudden fall seldome fails to foretell wett. therefore, It is not more y^e^ Space fallen, but y^e^ Manner of falling y^t^ is Most Indicatory of chang; for w^ch^ reason the Indexes of the va= ration, 'tituled, fair, Rain, &c. Is of litle use

Suddenness of y^e^ falling or rising is Most Indicatory for that Shew's More Contrariety In y^e^ air, to be Effectuall.

becaus there is No weather appropriated to those heights, but there may be fair or foul in most of them; as accidents of winds Mix= in In y^e^ air occasion. the Reason here is, the great Contrariety of temperatures makes wett. ffor If one come's to the other Gradually they coalesce, & become of the same temper as they mix, w^ch^ being slow, y^e^ Mercury falls slowly. but If one rusheth upon y^e^ other

the

the condensation, and generation of wett
must ffollow, & then ye Mercury ffalls Quick.

under S. winds Much falling, is agt Wind & storm oftner then wett, or so Much as is then Expected.

Another observation is that under Southern winds, very great Sinking of ye Mercury often brings ~~wind &~~ very high winds, more then rain And as wett weather is often ~~wett~~, windy, there may be such consequence of ye wind, as Shall prvent ye wett, ffor If it blow's Exceeding hard the raine is seldome Great, becaus the force of ye Wind bear's away ye Clouds & drops, so that litle shall fall. It seem's wind & wett attend often Each other, but are Not Constant Com=
panion's; ~~ye~~but so much as would perswade one they flow from one comon caus, & that is con=
densation, & Rarefaction but more of the former becaus when a valey is made In the air sphear the movements turne towards it to ffill it. but when an hill is raised, ye Movements are from it Into other parts. so that ye place where such occasion is, /in one case is more in ye other\ ~~is~~ less sensible of it. And when the

Wind & wett are from one Comon caus, for Inequality In ye surface of ye air sphear, setling againe to levell is a beginning of wind.

Rain is southerne without any signe of ye opposite by cold, yet it is mixture of air that causeth ye Wett. but It may Not appear to us. as when a warm wind is alow and ye cold aloft, wch often happen's, & ye alter=
nate also, and no conjunctures makes more wett in ye air then that, and More pervi=
cacious now

Resolves ~~68~~ ~~59~~.

Winds of Short Cours make litle or No alteration but Remote air [&?] sudden, hath y^e^ Great effect to chang weather.

Now it is universally to be Expected that short Reaches of winds makes litle altera= tion, but it is the long stretches, as when the air hath traveled farr, w^ch^ Introduceth chang of weather. In summer It often hap= pens that breezes blow from all points, and calmes shall Interpose; and generally In y^e^ Morning & Evening calme, & at Noon breze, sometimes out of the East, (for y^e^ reason of y^e^ trade winds), And No signe so much as a cloud for many days toge= ther. the reason is, there is No air comes from farr, so as to have a different temper. the air of Norfolk makes No chang In Middlesex, but If it comes from Norway and meet a warmer or southerne air here then it make's a hurry of wind or Wett. Therefore y^e^ observer may accuse the Instru= ment ffor failing his surest companion y^e^ wind, If he doe Not observe when wends are thro blewing, and when onely slight

While winds Stand in y^e^ Same Quarter or there be a Sort [of?] Calme (Except [s?]hort breezes) y^e^ Wea= ther cannot be wett or disturbed

breezes, and are but accidentall In a ge= nerall calme. ffor such is the condition when y^e^ air upon y^e^ Globe, is Quiet & doth Not travell, whereby y^e^ weather is allwais fair; and then small accidentall rarefactyions, & straitnings, will make such

curling

curling breezes as signifie litle. It is hard al=
wais to find out that difference, but there
may be Symptomes of it. As When ye Same
winds stand day, & Night, & blow strong,
or blow hard at Noon, & Calme til 9. & 3.
Seamen have this skill, and will Not venture
out In a voyage, upon a snatch of a wind
as they Call it, but stay till ye wind is Made.
It follows not that any wind however strong
& thro must make foul or fair weather
ffor that depends, on the thwarting & Mixing
of different-country-winds, as hath bin sayd.
but winds long standing from all Quarters
is fair, and vering & mixing foul, or tur=
bulent.

Most wett Comes from ye N. winds tho perhaps ye occasion may Not be perceivable.

This is at length bring's me to Consider ye
Northern winds In particular, wch, however
ye opposite are Reputed humid, are ye Caus
of it. And Much More bad weather comes
from the North, then from ye South. And yet,
wch distract's our ordinary observers, ye Mer=
cury under those winds will /rise\ ~~be upon rising,~~
So that is Most Necessary, In such cases,
to look out, or Expect concerning ye winds
abroad. If ye wind be Northing, & ye Mercury
ffalls, it is a sure signe of wett, and If very
low, cannot goe off, without Much
rain or Snow. It being a rule, that
under North winds high, & south low

mercury

mercury is to be Expected; And the More
Contrary to this ye Symptomes are the more
powerfull Effects's ffollow. I sayd that a
fals wind from ye North coming about by
ye South, shall offten be without wett; &
South Winds bending are much more wett then ye North, as condensing, While ye other rarefie.
onely cloudy & turbulent. but a fals
wind from ye South about by ye North sel=
dome failes of wett Enough. the reason of
this difference is, the former is In the Way
of rarefaction, and ye other of Condensa=
tion. And ye latter tends to wett Most, &
ye other to Wind Most. becaus Winds goe
for More room, wch /room\ is made by shrinking
rather then Swelling. There you have In
Generall why Northern winds Caus More wett
high Mercury & Miseling Sure sign of a N. wind. & that arived ye weather is fair.
then Southerne. Sometimes the Mercury
Shall stand very high, & ye weather, be
windy & Misling, or be it calme & wettish
ffor it will scarce Ever, In that case,
raine downeright; It is a sure signe of
the wind Coming about; as It will Infal=
libly, If that Constitution holds. And when
ye wind is Come Into ye North, all will be
Quiet, and fair weather but Cooler Suc=
ceeds. but If ye strife of ye winds hold, & ye
North, altho prvailed, Shall be veering

betwixt

62. Resolves

Strife of winds allwais make disorder & turbu=lence In ye air, tho perhaps not meer wett.

Betwixt NE. & N.W. It May be very Misling wether, and yet ye Mercury be very high. And the Great Stormes of wind wee usually have from ye S. &. N.W. are but a Strike between ye Northerne & South -erne Winds, and till one prvailes, there is No Quiet. as If a S.W. &. N.W. happen to Coalesce In a point, No wonder If there be such disorder, & wett. and with us, wtever is ye Caus of it, the N.W. are the Most Wet=-ting & tempestuous, It May be, becaus ~~ye~~ /those\ winds come in pinch't between ye Islands

The N.W. marine winds bring wett.

ye N. /often\ comes with a low mist afore it, but ye South ye clouds high

Note mists are usually due to ye N. Winds.

of Ireland & Brittaine, by ye Scotch shoar. wee that live upon ye N. & N.E. Coast of England, know ye Influence of a sudden access of a North wind, It shall bring a mist afore it, and then all wind and fury ffollow. And These shall creep by ye very Ground, whereas the southerne wett is ob=served to gather in ye air, by misty-clou=ding, at a distance, and comes Not Neer ye Earth but In Rain. And there is often from a North Wind pure mist driven /low\ In ye air and /yet\ below /next ye Ground is\ very dry; wch ye Country Men Call a sea Haake, or Haze. and is a signe of much drought. And when there are Externall threatts, or /ordinary\ shews of bad weather or good /as they Call it\ and there is in event ye Contrary it is

a

The Northerne air, heavyest & will be at bot= tom.

a sure signe of ~~drought~~ /no easy or ready alteration\, these observations give us occasion to think, that ye Northerne air Is heavyer then ye southerne, and It Must be so becaus more condens't, & Mr Boyle by Experiments hath proved it. so When those aires come over one & other, the Northerne will be undermost.

The Baroscope truer to ye Winds then to weather, and Indicates that onely as consequen= tiall, ye Wind being the Immediate /or first\ ac= tor upon it, & ye weather Conse= quentiall.

Now it will be asked what say's ye baroscope all this while; I can ansr that Generally it is true to its Winds. And WhatEver appearance according to ordinary expectation, there is of any ~~certain~~ sort of weather, If that doe Not concurr, or Contradict, No other signe is to be depended on. and Collating ye winds with ye Movement of ye Mercury, Strang prdiction's of ye weather are Made; I say Not there is /No\ ~~not any~~ Irregularity or cases anomolous, ffor What certeinty can there be /In ye Symptomes\ of things in themselves so very accidentall. ffor If one caus draw ye Mercury one way, and ye Weather is in a way to answer, there may be the di= -rect contrary caus super induc't, that will take some time to Reduce ye Cours, and so prcipitate chang clean contrary to Ex= pectation. In short, there can be No positive rule, as of a pendulum clock /is\ to Measure time, ffor prognostication of Weather, In those humid Incertain climes. perhaps In the trade wind

No Indication of event's so Incon= Stant as, weather can be Constant.

trade-wind Regions, there may be More of
In y^e Extreams of climates the Baroscope Most sure: for w^{ch} care=-full observations are desired.
the Regular, and the Comon tho tremendous Stormes & hurricanes they have, may be su= rely foreseen. but I have No Intelligence of those Matter's, and wish y^e Instrument were translated & well observed there. Where Caus[es?] doe Not Cross one & other so offten and So sud[=?] ~~del~~ denly as here with us. I am sure a sound Hypothesis, If I miss, whoever lights on it, ffor solving the reason of the variations of the mercury, and weather; will be very assisting to gaine usefull rules in using y^e Instrument. but I Must owne, If this fail, I never yet heard of a ~~tollaber~~ tollerable one.

I Shall conclude with this observation to Con=
frost is the hig/h\est station, from y^e croud of Dens air from y^e North Swel= ling, when brought South ward.
firme the p^rmisses, that In winter, & y^e Coldest weather, especially clear frost Northerly. winds Reigning. the Mercury stands at y^e high[=?] est pitch. ffor then y^e air comes very dens from y^e Cold Region's, and is strangely heaped up by rarefaction towards y^e South, while Mor[e?] is Continually urging from y^e North, If y^e meer weight be Not as I ~~guess~~ /say\ it is by density hea= vyer then y^e warm. Snow comes after y^e Same
Standing Still y^e surest signe of Con= tinuance of Wind & weather.
signes as Rain; A fall is almost a sure Signe of a thaw. but /long\ standing very still, con[=?] firmes all sort's of weather, so as Not to Chan[g?] till y^e Instrument Gives warning.

<flourish underline> <flourish underline>

Resolves ~~71~~ ~~65~~.

ffew attempt's to Resolve y^e^ action of Springs, but from y^e^ Comonness, folk thinck they under= Stand things when they doe Not so.

The Next Matter I shall take In hand to discours of is, the nature of springs and pen= dulous Motion's. That of Springs is a Mistery w^ch^ is Not more abstruse~~, then~~ as to y^e^ solution, then obvious & comon, as to y^e^ use and obser= vation of it. And I Never yet heard of any attempt to hammer out a Resolution of it; but it is taken as a princip~~al~~/le\ in Nature, & passeth by y^e^ warrant of y^e^ Word Elasticity.[392] y^e^ Subject is priveledged as Many others are, w^ch^ are So common, Men thinck they understand= them, and when asked what & how? they answering to y^e^ poropose, must needs say, I /doe Not know\ durst have sworne I did. And It is found Even among y^e^ ancients, as well as y^e^ vulgar, (& to say truth, as to phisicks, wee see Not much difference) that If any unusuall thing, can be Made like to one usuall, It was account Enough to be given off it. Without thincking

philosofers to countenance Ig= Norances, & Make it look like knowledg Referr to what they underStand not to principles, & so S^r^ Is. N. &c. Make Springynes a principle

of Resolving such usuall thing's, tho ~~Such are~~ /in themselves\ most abstruse, Supposing there is no need to give a reason, for what is so Comon. It is wonderfull what els could divest so Necessa= ry Inquiry; It may be desperation of suc= ceeding; or Ignorance of the Whole texture and /minute\ Materialls on w^ch^ springs depend, May have

[392] See note on f. 87r, above.

66. Resolves

have diverted such phisicall attempts, and disposed ye vertuosi, as Now it is a Mode With them to Referr spring, or Elasticity to a prin= ciple; and accordingly they hold, that body is Indued with Elasticity, as a property of it. some More or some less, and some perhaps without any spring as lead. butter. &c. And from thence they have derived Motive Reflections, and divers rules of Impulses. agt wch I have sayd Enough, that is In a word, that such fancy's are Inconsistent with ye nature & Essence of body, wch hath but one property yt wee know, wch is to be Impenetrable. And motion Needs so such shifts, being better Resolved upon ye admitted property of body, then by Inventing a New one. So Now it Remaines with mee, yt Exclaime on these omission's, to Make amends by Some advance of My owne; wch, as one who delights In abstrusity's of this sort, /I\ shall Not fail to venture upon.

That wch is the spring of Comon air, is In truth ye vigor of all Met= tallin, & other Spring's, considered under proper Cir= cumstances.

Wee have discoursed at larg about ye Spring of the air, and drawne ye Mechanick Solution of it, from rarefaction, & /such\ Confinement. ~~but~~ ~~Such~~ as holds ye air, & lett's ye Interstitiall matter pass free. Now I consider that Nature is Not fantasticall, to affect variety's, but is generally uniforme, and acts by like

means

means; therefore I have Concluded that all springyness In ye world, however Exposed to us, is from No other but ye very same Me= chanicall disposition of Matter, & the Mo= tion's of it. ffor If wee Cram a pipe of leather full of blown bladders, & Shut them In. What Is that but a Spring? and Why should a wire hair, feather, or ought Els yt is Springy, be ac= tuated In any other Manner, /then\ ~~that is~~ by /a sort of\ air Included, perhaps Not ye air wee breath, but a more subtile, and no less rarefyable. wch being by flexure of ye body compressed /& so ye Spaces conteining in it Made Straiter\ by the Elater of it tends to set ye body in that posture, In wch the subtile Included matter, is permitted the greatest Expansion ye Spaces will allow. & there it Stands. Thus the spring of the air, is ye Mother of all Spring's of ye univers, and that understood, and ye caus of it Granted, all o= ther Springs are Consequentially Resolved.

Explained by a flexible tube full of blowne bladders, wch Will Not Stand Crooked.

To support this opinion, Wee Must Repair to Experiments, wch are at hand, so comon is the phenomenon, and /also\ Consider well, ye Condi= tion's of springy body's, and as well how they may loos or gaine a Spring; ffor it is certein that both one & other happen's to divers bodys, wch argues It is Not a principle Inherent, for then it would Never depart out of its. ffirst

An acco of Springy body, & by the Genesis of them they become Sprin= gy, & by any disso= lution of texture become Springless.

68. Resolves.

All vegetables are Springy, as wood principally
but so too also y^e^ Stalks of most plants, If they
are of a substance or consistency apt for it.
Then all Mettalls, after purged from Earth &
Glass; but such May be made to loos their Spring.
All fryables, as stones, Glass, pitch Rosin, & y^e^
like. but Most of all, body's drawne out Into
length, after y^e^ manner of vegetation, gaine
a spring, and May loos it. thus Glass drawne
out is very Springy. So wire w^ch^ is drawne by
compression through strait holes, to great length.
And watch Springs, with a Compression by y^e^
lapp of one Edg of a barr of Iron over another,
but Not Ill rep^r^sented by passing an hair, pres't
over a thumb nail, w^ch^ will make it curle
as a watch spring. The tendon's & Membranes
of animalls, w^ch^ might be Reckoned among
vegetables, but for y^e^ dignity of life; And ~~of~~
~~such~~, No artifice of a Spring was ever com=
parable with a Muscle, as May be Shewed
y^t^ an animall is but a Compage of Springs
that have dependance & play, /as equilibrated by\ ~~upon~~ the
Intercours they have one with another. these
are the list of Springy body's; those Not So,
may be touched upon, when there is occasion.

vegetables are bundles of hollow tubes, & thence y^e^ Spring.

As for vegetables, wee know them to be one=
ly a bundle of tubes, In w^ch^ fluids, & air with y^e^
Rest.

Rest have a Cours; as D^r^. Grew hath most E=
laborately demonstrated In his Anatomy of
plants.[393] But I thinck that In that peice, he is wan=
ting In one thing, w^ch^ is In Not Examining Rot=
ten wood, as well as Sound, ffor y^e^ vessells, appear
Incomparably better In y^e^ Rotten, as y^e^ bare Eye
will /in\forme. ffor I have found wood under Ground
Dry rotten, w^ch^ hath bin /apparently\ Nothing but tubes as
an hony comb /packt\ close together. It is possible y^t^
within these so visible tubes, there May have bin
(but Consumed) other bundles of tunes, and So
small as to defye y^e^ Microscope; ffor In such it
Is that Spring Resides ~~in~~. Now what can be=
Imagined more apt to Spring, for y^e^ reason I
have given of Springs; then these vegetated
bunches; of y^e^ Each tubule, may be as y^e^ lea=
ther pipe Stufft with blowne bladders. but admit=
fire ennervates -ting, y^e^ tube to Restore its place. It seem's that fire
Springs In wood without Incineration, will deprive this spring.
If reduc't to Coal. ffor In the Charcoal hearths, where y^e^ Straw
about wood, turnes to meer Coal. but so
britle, that one cannot bend any part E=
-nough to prove it hath any Spring left. and
no wonder, after the fire hath made vents to
all y^e^ tubes, and lett out y^e^ Springy Fluids In them.

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[393] Nehemiah Grew (1641-1712) studied first at Cambridge, and then as a physician in Leiden. His *Anatomy of Plants* appeared in 1682. The project started with "The Anatomy of Vegetables begun", a paper presented to the Royal Society in 1670 (he was in Leiden at the time, the paper was presented by Wilkins). His Anatomy relied on close examination of plant materials under a microscope. After his return to London he became involved with the Royal Society and succeeded Oldenberg as Secretary, editing a volume of the *Transactions*. A first edition of *The Anatomy of Plants* can be seen at http://www.botanicus.org/item/31753000008869

70. Resolves

All Animall Sub= Stances, are compact of hollow vessells, & tubes.

I may here Subjoyne y^e^ Consideration of animall substances, w^ch^ are all but a Mass of vessells, y^e^ very bones, when dryed are found to be but more rigid tubes within, made up In a case of foraminous [defens?].. the hair are all tubes as Canes, and there is No doubdt, but besides y^e^ pith w^ch^ is so hollow, y^e^ Substance, as that of Canes, is but compact tubes, but wee can= not by any mean's discerne so small, & In Such cases wee must Judg by analogy. The skin is a texture of tubes unaccount= tably Interwoven. the very parenchima[394] are farthells of vessells; that is y^e^ Muscles & tendon's, w^ch^ are Ever under some tension The motion of y^e^ humor's In a fishe's tail Shew y^e^ whole fabrick of that Membrane is vessells;[395] and surely some have air, as others liquor and lumps of digested Matter, w^ch^ is blood. That such vessells having compres= sible fluids In them (. w^ch^ I may call air, tho No part of y^e^ air Sphear, but as Interstitial to it) being put out of their formed postur[e?] contract & compressing y^e^ Included air have a manifest Springyness,

I have often Considered of Some Image whereby to Expose this notion to the or= dinary apprehension, w^ch^ will Never take In minute thing's, but by a Mentall In[=?] largem^t^ of them, and proposing some Gross Representation's, such as fall under sence.

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[394] i.e., parenchyma; note how here, and on the next page when he uses the term 'mesentery', RN employs correct anatomical terms very precisely. With his employment of loan words from other languages, technical terms from his wide and well-digested reading of specialist texts (for example, 'foraminous'), and his command of a lamination of Englishes (from Norfolk to Whitehall - for example, 'farthell'), RN has an enormous vocabulary. There are 1229 quotations/references cited in 1125 entries in the present online OED (about the same as Andrew Marvell, this is written in June 2014). But bear in mind that the editors of the OED know only his printed works, had they access to his full MSS writings, RN might be one of dictionary's most cited authors and stand out as having one of the most inventive and capacious vocabularies in the recorded history of the English language.

[395] *See* note on f. 179v.

Resolves. ~~74~~ ~~71.~~

An history to adumbrate, y^e^ Springyness of live flesh.

And this an history Related of Leonardo da vinci furnisheth,[396] ~~ffor tho~~ /he was\ a painter and Excellent in his way, and Moreover very capricious & full or tricks. he used to Joyne Gutts together, so as to be tight as to Wind, & keep them In a vessell In his chamber with water. And when some comp^a^ came that he Intended to Impose upon, he Would p^r^tend to goe Into his Study; and there ha= ving a pipe Contrived on porpose, he would blow up his Gutts, & those rising & folding about, would neer fill his chamber, & drive away y^e^ Guests in a fright as If satan himself were there. but to Contract this I= mage. take the Gutts of one beast, & free them from y^e^ Mesentery; those Empty are as a Substance without any Spring, but blow them up, & they will Curle & fold ac= cording to their shapes; and being hard blowne, Rep^r^sent the spring of human flesh exactly. so as If you take them by one part holding y^e^ other, there shall be a mani= fest Spring drawing them towards their true shape againe. And thus is the Motion of y^e^ Muscles performed. So that Springs have allwais a Naturall, and a forc't pos= ture; In y^e^ former y^e^ passages are ~~In~~/at\large & and in y^e^ other Contracted, whereby y^e^ Included air

The Muscles are made up of curled tubes, w^ch^ Strait= ten Into y^e^ tendon. The Nutriment is of y^e^ air In Such tubes, w^ch^ may be called Spirit, be= caus it animates y^e^ flesh.

[396] Leonardo da Vinci (1452-1519). This story is told in Vasari's Life of Leonardo (Giorgio Vasari, *Le vite de' più eccellenti pittori, scultori ed architetti, etc.*, Florence 1550 & 1568). The *Lives* were not translated into English until the nineteenth century, but there were several sources in various languages that RN may have used, furthermore this was a widely anthologised story. He may even have been told the story by his close friend Peter Lely; let us opt for a proof vacation, and prefer to believe that.

air Makes ye Spring, tending to Reduce
them to the naturall againe.

Mettalls Wrought out, have Spring and heat again or Nealed loos it.

All Mettalls by working acquire a Spring
and by fire it is lett loos againe, wch once
for all is Instanced by Comon wire, of what
Mettall soever it is made. ffor In the
drawing of it thro ye foramina of ye wire pla[te?]
the mettall is Crowded Into More length &
It is observed that If a Mettall be hollow
ye Smallest wire can be made of it shall [be?]
hollow also. So Glass ꝑ blowed, & drawne
out Into a tube, if that tube be fluxt a=
gaine, & drawne Into a thred, as will hap[=?]
pen, almost Imperceptible; that thred Shall
be also a tube, & hollow, as they find by Co=
loured liquors Insinuating Into it. Now as
these manifest cavity's, Continue thro all
the wire drawing operation. So Every other
cavity of ye Mettall, is Continued, and If roun[d?]
made oblong, and If oblong Made longer
Whereby the Mettall becomes a compage
of ~~long~~ oblong pores, And what /spirit\ fluid, or air
(as I must call it) was In them before, Con=
tinues after ye operation; wee Supposing it
such as doth not permeate ye body of ye
mettall by those small pores, wch may
be free for yet a finer matter to pass. Just
as In the derelicted Space there is a Matter
but

but such as readyly permeates Glass, w^ch^
y^e^ Externall air cannot doe. Thus to Come
Springy body's all full of Cavitys of Some Sort or o= ther, W^ch^ Contract by flexure. at a just Notion of Springs, wee Must Magnifie'. and Imagine, that In springy body's there are considerable cavity's and tubes as bladders & Gutts full of air; & such as Cannot upon Compression Escape, then upon flexure, If that air hath a spring, the body Must shew it, by y^e^ Re= sult it make's Into the formed posture, that it Requires. Thus wire is Springy as None More, but If you bring it to y^e^ fire, & Make it Redd hott, w^ch^ they Call Nealing, all the Spring is gon; becaus the fire hath opened the passages and freed y^e^ Included air. and till It be wrought over againe, so as to Make New closure, there will be No spring, or very litle In it. So all hammered Iron hath
How mettalline Spring's are Made according to art. a spring, becaus y^e^ mettall is driven out and passages closed. And there is a way found out to take away y^e^. brittleness of Iron, and conserve y^e^ Spring, or to Make [it?] ~~the Spring~~ persevere more. by cooling it In a certein manner, as locksmith's use. And it is found that spring's by being long bent loos their force; becaus that air w^ch^ was compres't, by y^e^ agitation ordinary In

the

the Interstices of things; altering In some measure y^e position of parts, w^{ch} is More or less freed, & thereby the spring failes. These and Indeed all conditions of Springs, shew that such vertue is Not a property Inherent In y^e body, but adventitious, according to the posture and disposition of minute parts.

The Minutenes of y^e parcells of Elas= tick fluid In the Cavity's, hath a complement by Number, so as to make out such a force, as Wee know they have.

It will be opposed to us, that It is Not pro[=?] bable, that such vast & pertinacious force Can Result from such minute Quantity's as wee must suppose Reside in y^e pores of a solid body. to w^{ch} I ans^r, that Minute or not minute, make No objection as to y^e force If many are found to compensate for Mi[=?] nuteness. so I have already, In y^e buissness of light, made y^e whole Interposing matter between us & y^e Sun, to be moved by y^e Strokes of y^e combusted matter. small as it is. becaus y^e Number of concurrent strokes, make up for y^e Magnitude moved. In y^e Same manner such Numbers of cells, as body's have wor= king together,[397] may well, rais such a force as a Spring hath.

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[397] Robert Hooke described the conjoined elements which under magnification appeared to compose a piece of cork as '*cellulae*' (meaning 'rooms'; *see* his *Micrographia, etc.* 1665, especially Observation XVIII). Hooke also calls the spaces 'pores' and noted that cork is largely made up of empty space between membranes; he also compared the appearance of cork to honeycomb and froth. Observation XVIII contained Hooke's own (very similar) refections on the relation of empty spaces within vegetable materials and their 'springyness'. RN's notion of the tubular or cellular structure of organic forms was therefore a commonplace, especially among those who had access to such images as were found in the *Micrographia* (which had been, of course, a best-seller). RN's neo-cartesian theory of some linking material between matter and spirit, the ether, or 'subtile matter', was extremely controversial, as was his use of its presence in any material (metals, for example) as an explanation of elasticity. What is perhaps most significantly characteristic here is RN's investment in a radically reduced and simplified set of general laws to explain all manifestations in nature, linking elasticity in metals to the projection of light from luminous bodies. The general theory of cells as the building blocks of all forms of organic life (what we know as cell biology) was only developed in the nineteenth century.

Resolves ~~76~~ ~~75~~.

Concerning Springs of watter, ye for clearness, are ter= med onely foun= taines.

Having sayd so Much of springs, I cannot but ffall on another subject very unlike, but of the same Name, for wch reason I must use a different word, & that shall be fountaines, ffor springs /but those\ of water, [Sə?] /onely wch are\ generally found to flow from ye Earth in Most parts of ye World.

such come Not from ye Sea, as higher then ye land, as some have most Ignorantly delivered.

It would amaze one to see what Extravagant fancy's have gone abroad for ye Caus of foun= taines. some say ye Sea is higher then ye land (a delusion, for want of understanding ye reason of perspective.) & so it run's out again at ye cranny's of the Earth sweetned In ye passage by percolation. This /conclusion\ Is Inconsis= tent with ye prmisses, wch is yt ye sea is higher for If it [run's?] downeward thro ye Earth, why doth it Not ffall all /in\, & drowne ye World. provi= dence forbids. true. but why must providence make a diseas, yt is ye Sea out of level, to cure againe by meer power to keep it so, and then let it goe by litle & litle, In ye Issues of fountaines? but, ~~It is~~ Next to /holding\ such opinions, ~~a fault~~ /It is Impertinence\ to confute them. yet the Great Stillingfleet In his origines[398] holds forth this opinion as ye most probable, and thence Induceth ye Naturall mean's of ye Grand de= luge, as a letting ye Sea loos. perhaps his understanding was Above such Inventions but

such opinion found In ye original sacred and made use of to dismiracle ye universall deluge.

[398] i.e., Bishop Edward Stillingfleet (1635-99); RN is here referring to *Origines Sacrae, Or, A Rational Account of the Grounds of Christian Faith, as to the Truth and Divine Authority of the Scriptures, and Matters Therein Contained*, London, 1662, a defence of the literal reading of the Bible (as opposed to interpreting it in terms, say, of allegories, or historically).

76. Resolves

but thought it vulgar, & so plausible, w^ch^
served his turne. but I must say to him &
all those Monster's In theology, that Make
it their buissness to Render a most emi=
nent & undoubdted Miracle a Naturall pro=
duction, they doe Neither Religion Nor
their owne Integrity, as to y^e^ fame of it, Much
Service, Whatever happen's to their witt,
of w^ch^ perhaps they are most fond & proud.

Subterranean cisternes, & vapours from them, Not the caus of Springs. for Non constat of any such.

Other's say (for I would Choos the most
plausible,) that there are subterrranean Ca=
vity's filled with water, & perhaps comuni=
cate with y^e^ Sea; and y^e^ heat's in y^e^ bowells
of y^e^ Earth, raiseth vapour, w^ch^ meeting with
y^e^ cold air about y^e^ Surface, are disjected in
water, & so /gathering together\ vent where/al\ conduct's
lead
This is more reasonable. but why must wee
Imagine such cess-pool's In y^e^ Earth, who
Ever (but [~~if~~?][399] the all p^r^suming Kircher) Could
say what, where, & how they were, /or\ ~~of~~ If any
were at all, or Not? but he hath assigned
them their seats In divers part's of y^e^ World
with their comunication's, & vents. and
layd the marine vortexes or Gulphs (~~If any~~ /as If\
Such /really\ were) to correspond them; & I know Not
what chimera's besides, It is ~~ceret~~ certein y^e^
cold about y^e^ Earth turnes /much of\ it into water.

[399] 'if' scraped/washed out.

Rain water a great but Not Sole caus of Springs

others will have ~~Springs~~ fountaines to proceed meerly from rain water, Setling Into y^e^ Earth, and Issuing in lower places, by way of filtration or percolation. To this Much will be ascribed, but Not all the Caus of Springs ffor It will Not Quadrate with springs in Stony Country's, w^ch^ have litle of No perco= lation, and shall vent plentifully neer y^e^ Summits (tho Not altogether so high,) as the highest hills.

Now In order to Investigate y^e^ true Caus of /fountaines\ Springs, I shall observe first what is y^e^ state of them as I have observed, and then bring together all y^e^ knowne cause's I can shew of producing water; And Rejecting all p^r^carious Invention's used to serve y^e^ turne.

In percolating Soyle, water sel= dome Issues but at bottom In y^e^ valleys.

Great Notice is to be taken of y^e^ Countrys where ffountaines are. If they are sandy or chalky, or Gravell, & y^e^ like. water is sel= dome found to Issue but at y^e^ very bottoms or valley's. And where great River's are, there are usually multitudes of bubbling foun= taines In y^e^ Confines of them. otherwise water is Not obteined, but by wells, y^t^ is sinking pitts Into y^e^ Earth downe as low, or near it, as are y^e^ Neighbouring Rivers, and there are found water's plenty, but such as may be drawn

That & ye Water of wells, sympa= thising wth drought Shew rain water to have cheifly to doe with them.

drawne off, faster then they follow, Especially after long drought, when as they say, springs are low. for then, Many well's are wholly dry and all Niggardly of their water, wch have plenty In Wett times, and In ye Spring follow[=?] ing a Moist winter. All wch is a demons= tration, that Rain Water, hath ye. Greatest Shar[e?] in the water's of these fountaines.

The Contrary, In Rocky & Moun= tanous stony pla= ces, where foun= taines, are More Copious Every Way.

But If the country be Mountainous, stony & full of Grotto's, & cavity's, Spring's or foun[=?] taines are plenty, frequent, & Inexhaustible and Not much, If any thing Influenced by drought, but are perennall, & copious, In al[l?] seasons. This Shews that Rain water hath Not Much concerne with such fountaines ye rather, becaus they are Not More at ye bot= toms of ye Country, then on ye Sides of ye hills [&?] often neer ye very summit of them.

so discovered Here 2 causes yt produce fountaines 1. Rain water,

From hence wee Gather 2. causes of ffoun= taine water. the first is rain water, such as falls In showers or mist's, upon ye Surface of ye Earth, wch Sincks, & by continuall per= colation comes downe to a levell, where water's begin to want vent, & thereabouts a vent is welcome, & Shall have water; but higher None, becaus ye waters vent still by percolation. And as ye water's are plentiful[l?] from Extraordinary Raines, so ye vents belo[w?]

are

Note
What vast Quantity
of water falls in rain
proved by a [comon-?]
vessell set out In a
shou'r, & ye depth
of water it Receivs

are charged, and discharg with more plenty
& violence, & grow lean again In droughts
when ye supply from above failes, or follows
not so fast. but yet I must demand a far=
ther reason ffor a supply of these waters
to percolate besides ye rain, wch will fall in
More properly when I have done with ye case
of Rocky Countrys.

Water breeds In
ye Grott's clefts &
Rift's of Stone in
Greatest plenty,
after ye Manner
& Reason of dis=
tillation.

It May Now seem strang, that such should
have most plenty of water, wch conteins None
ffor What water Can lodg In a stone. but
ye Reason is the Many cavity's, such as are
called Grotts, and Numberless Crevises or
clefts On ye Rocks, as wee see by ye Quari's of Stone
from them. That /ye dayly heat of ye Sun\ heat Cannot come
at these
Grotts & cleft's, no more then ye accidentall
colds, yt are In ye air abroad, is Manifest,
wch makes folks say, cellars & wells, are
Cold in Sumer & hot in Winter, that is
being Most of an Even temper seem so.
But Air Is apt to pass thro all places yt have
vent; as If there be cleft's In a rock, ye air
Shall enter & creep along by all the crevi~~s~~ces
In it, and Issue at other places less urged by
ye Wind, making Numberless track's & Me=
ander's In passing. But In ye larg Grotts &
Caverns, ye air Is Some what more Exposed,
and partakes of the heat & Cold of the
~~outsides~~ \outward/

outward temperature. And whatsoever Enters
by Wind, is so; and If there be any washing
by Condensation, It is Supplyed from abroad. but
all this while ye Stone is Cold, the day gives
that litle or No heat, but Morning Noon &
Night It is still Cold; and so Cold that Com=
mon air, must discharg water upon it. Espe=
cially If ye air be ~~accin~~ accessionall and
bring's a warmth from ye temperature abroad
And upon this I found ye Caus of fountaines
In Rocky Country's; wch to Explain.

That ye air falling on Cool Solids, yt suck not, makes a flow of water

That water will grow plentifully out of
ye air, upon any thing that is Cool In it, is
manifest from all manner of Experimts
as hath bin fusely observed Elswhere. In
particular that Notorious Instance of Marbl[e?]
wch doth Not suck in water, is dayly observe[d?]

Experiments of it

ffor when ye air Is In a certein disposition
wch I take to be such as makes it breed Wa[=?]
ter in it self, tending to Clouds & rain; It
Shall discharg upon ye Marble water In
great plenty. and If any accidentall Cold
possesseth ye Marble, or Glass, or any thing, as
/cool\ wine in a Glass; or /Els\ heating ye air, as ye Sun
on ye door of a Coach[400] when ye Glass is down[e?]
one or other so ye air & ye Stone & Glass ar[e?]
of a different temperature, & ye Cold [any part?]
of ye latter, water will flow Most Conspicuously

Air

[400] *See* BM Add MSS 32546, f. 312v, for a captivating version of this observation from experience.

Resolves. ~~79~~ ~~81~~.

That air Must depose water on cold Stone.

Air is generally warm, becaus it hath its form from Motion, but stone is cold, becaus It hath its forme Rest. No wonder air is deprived of its forme, In some Measure by Stone, when water Gather's upon it, w^ch^ y^e^ air, Generally being Evaporated water, generates by loosing y^e^ aeriall forme, & Relapsing Into that of water. It is Impossi= ble a place Should be cool, & drye; ffor w^ch^ I appeal to all Cellar's, wells, Grottes, & Even such as are made for pleasure; w^ch^ with y^e^ ~~drought~~ coolness, will allwais be Rafty, & wett. And If moisture be unwholesome, It is not very healthfull to pass much time in Such places. And this Not by ffitts, as abroad In Evening's & morning's, or certein seasons accidentally, but perpetually; so that Mois= ture and Cold are seldome In close places a= sunder, If I say'd Never, I thinck I Erred Not

Application of y^e^ former causes to Rocky Hills.

All this considered It will readily be Con= ceived how all cavity's and cleft's of rock that ~~hath~~ /have\ air In them, Supplyed from abroad Must largely produce water; the rather be= Caus the urging Winds, drive thro them fresh air, that brings y^e^ Externall warmth allong

with

with it, and Not onely In ye Cavity's, but /in\ all
ye clefts & passages as [goes?], produces water.
And that Never there turnes to air againe
~~but~~ yt is dry's up, but draines away, & finds
vent some where or other, & Whereever it is,
It becomes a fountaine. This is Confirmed by
one observation, wch is that a Country, tho
Stony, If ye Stone be sandy, or In ye Nature
of Earth, so as to suck up water, there are
Not Such plenty of Spring's Nor of that Na=
ture, as where ye Stone is Rocky as Marble
that suck's In No water. another observa[=?]
tion Confirming this, is that Spring-water
is Generally Cold, wch shews It comes from
cold places. But when such water is hot
as at Bath, & other places, It is from Causes
Not generall, or Concerned in ye production
of ye Water but accidentall, from different Sal[t?]
mixing, such as ye Chemists call Acid & alcal[y?]
wch never meet but calefie, & are are turbulent
that Water percolating a Soyl, or washing
Rock's where salts are Must Gather them, is
Granted, then If salt's have such property's
as being collected to-gether shall heat; the[re?]
Is No wonder at all that Bath waters
May be hott, from the accident's In the
passage and Collection of them. It is also
observable

Sucking Stone is as Earth, and doth Not create water, as hard Stone doth.

ffountaine wa= ter, generally Cold, wch Speak's its pe= digree.

Hot fountaines from accidentall Mixtures of acid [or?] aleatious Salts In them.

observable, & well knowne to ye Cost of
Miners, that all grotto's In ye Earth have Much
Of Oaky hole, In wett flow from them, there is one In somersethire
somerset Shire, & famous Enough Called Oaky hole;[401] wch folks
chedder-cliffs & visit for curiosity, becaus It leads great
ye water yt flows length's Into ye bowels if ye hill, where Strang
from them, see Cavernes are found. there is a perpetuall
Gibsons, Cambden. Current from this valt, wch issues among ye
Stones, as they Enter. And ye sides vent water
as also ye topp, where are pendant the pe=
trified (Icisickles of) water, as I may from ye
Exact & forme terme them. the sight of this
caverne is almost a demonstration of what
I say, & there I leav it.

In Earthy hills It Remaines that I Shew how farr this ge=
& country's, ye air neration of water, from ye air, Is Concerned In
about ye Surface ye Interteranean water's of sandy Country's.
of ye Earth breeds And I must affirme it to be Not a litle.
much water, on ffor the Earth it self tho It seem's hard and
like accº as a= Compact to us, yet is In it self foraminous
mong Rocks, but and air is dispers't all about more or less in
not so plentifully it; And there for ye Same Reason Ingenders
water. And however it is Not so plentifull
yet it is some what, and Serves to keep ye
Earth moist. ffor If there were Not such a
production of moisture, In dry times, or
Inter tropicall Country's, many places
would

[401] i.e., Wookey Hole in Somerset.

Thence ordina=
ray vegetation
Maintained in
Drye times.

would become perfectly arid, & sterill, and
Not Nourish so much as deep rooted trees. but
It is so farr otherwise, that dig In any part
of ye World, I will Not Except ye Sands In ye
desert's of Arabia, but If Not Newly Moved
I mean having layn Still & Not run, at a
foot or less depth, Moisture will be found.
wch Must breed, and Not be had from without.
If In a drye time there fall's Much rain,
and drought ensues, If ye Earth be broke it
will Not be found yt ye wett hath penetrated
Many Inches; but how farr shall be visible,
and the rest of ye Moisture found underneath
is bredd.

But this breeding of water In ye Mould or
ye Earth, keeps it so Moist, that If it doth Not
drein so as to conduce ro maintenance of,
Springs, as I verily beleev it doth, and Con=
siderably; yet It accomodates the passage
of ye Recruits by Rain when they fall, wch
otherwise would all be held suck't In by ye
dry Mould, but finding that wett, & ready
to drein goes along, & strait makes a Cours
towards ye vents or fountaine.

And another considerable thing depends
on this, yt is vegetation not onely of trees,
wch have deep root (and are observed
never

never to want Moisture at y^e^ Root) but Com=
mon Herbs upon y^e^ surface of the ground, besides
y^e^ falling of dew's, have a [Recruit?] of Moisture
from this caus. ffor y^e^ outward Insinuating
among y^e^ herbs & Grass, & y^e^ Cavernules of
y^e^ Mould In w^ch^ their roots run, heaving it
up, & Making ~~it~~ /y^e^ soyle Cool\ as they terme it, from y^e^
chang of temper between Night & day Even
In y^e^ dryest seasons, generates a Moisture
w^ch^ serves In great measure to maintaine
such plant's, y^t^ Els In a dry time Must all
perish root & branch. but It is observed y^t^ If
y^e^ blade of Grass dy's, y^e^ root lives, & is ready to
Moisture breedS in y^e^ Shade of Corne & Grass.
put forth when Raine comes. And corne w^ch^ is
an annuall, If growne up thick, breeds a Moi=
ture under y^e^ Shade of it, w^ch^ maintaines its
Growth thro a dry season. All w^ch^ Shews of
what use to y^e^ living world this cours of ge=
nerating water, In y^e^ Alternation's of heat
A Cold, as well as ag^t^ perpetuall Cold, is; for
without it, Nature would Seem to dye.

Now take all together, Rain water, & water
breeding In y^e^ Cold Earth from y^e^ air, especially
In Rocky Cavernous Country's, makes the
phenomena of fountaines In all y^e^ Condi=
tion's of them, Resolvable enough without
Recours, to Miracles or prodigious Inven=
tions such as use to be had for y^e^ End & porpose.

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<Red BM stamp>

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<In pencil:
'346 folios Jan. 1886 [plus two sets of initials]'>

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[colophon i]
(binder's paper)
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[colophon ii]
(binder's paper)

<label attached

'DEPARTMENT OF MANUSCRIPTS

Record of Treatment, Extraction, Repair etc.
of M.S. no Add. Ms. 32545

Date	Particulars	Name
20.01.06	ff. 77-78 repaired with gelatine coated Japanese tissue activated with IMS/water	Signature
15/02/06	Examined after treatment.	Signature'>

[colophon iii]
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