Excellent compendium of musick / Renatus Des-Cartes. With necessary and judicious animadversions thereupon. By a person of honour.

Contributors

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(by Descartes)
Written during military service (1617 – 21) for Prince Maurice of Orange. Got to know Isaac Beekman, of Dort. MS entrusted to Beekman. Published after D's death in 1650. Immediately preceded the period in an oven !!.

It might be the first thing he wrote
He had already, before 1612, met Mersenne
Mersenne & he were schoolfellows at Jesuit Coll
L'Harmonie Universelle written 1636

M. Wittilow
early Decart

p64. Ref Mersenne, Kircher, Morley

RENATUS DES-CARTES
EXCELLENT
COMPENDIUM
OF
MUSICK:
WITH
Necessary and Judicious
ANIMADVERSIONS
Thereupon.

By a Person of HONOUR.

London, Printed by *Thomas Harper*, for *Humphrey Moseley*, and are to bee sold at his Shop at the Signe of the *Princes Armes* in S. *Pauls* Church-Yard, and by *Thomas Heath* in *Coven Garden*. 1653.

THE STATIONER

To the Ingenious

READER,

&c.

SIR:

NO sooner can your Eye have taken in the Title of this thin Volume, which I have, in some latitude of Assistance, Midwiv'd into this our English World; but you shall most willingly

ly confesse it to be as well a sufficient Justification *to my* Industry *and* Cost, *as a full* Elogie *to* it selfe: *The AUTHOR thereof, being one of the fairest Flowers in that Garland of the* Mathematicks, *wherewith this* Century *being meritoriously adorned, may, without breach of Modesty, take the right hand of* Antiquity, *and stand as well the* Wonder, *as* Envy *of* Posterity: *and so gratefully acknowledged by all, whose Studies and Ingenuity have qualified them with Judgement enough to profound the sense of his* Geometry *and* Algebra. *And its SUBJECT so universally* Gratefull; *that I dare say, you have not, in all your Readings, met with the Name of any Person, except onely* Tacitus *the Emperour, who was so rude and harsh of Disposition, as to dislike the* Melody *of* Numbers.

Concerning the AUTHOR, therefore,

the

the most your selfe can judge me fit to say, is only this; that the most becoming Tribute I can pay unto his Noble Memory, *is a silent* Veneration: *it being almost of Necessity, that a* Panegyrick *on Him from my unequall Pen, be interpreted a kind of implicite* Diminution; *since it must suppose the* Height *of His* Merit *to be commensurable by the* Digits *of so slender a* Capacity; *and few will admit Him for a Competent* Doxologist, *who is, by incomputable distances, below a due Apprehension of the* Excellences *of his* Subject.

And, as for the SUBJECT likewise, wherewith the Rationall Soule of Man *is so Pathetically, and by a kinde of occult* Magnetisme, *Affected, that even the most* Rigid *and* Barbarous *have ever Confest it to be the most potent Charme either to* Excite, *or* Compose *the most vehement* Passi-

ons *thereof*; *as* Homer *ingeniously intimates in his Figment, that it was the Custome of the* Gods, *to pacifie their Civil Dissentions with the Harmony of Musick, and that the Rough spirited* Achilles, *with the soft Concordant* Echoes *of his owne* Harp, *used to Calme the tumultuous æstuation of his* Choler; *and as all* Poets *unanimously intend, in that they have made the* Magick *of* Sirens *to consist only in the* sweet Accents *and* Melotheticall Modulation *of their* Voices: *Concerning this, I say, it would sound a mere* Pleonasme *for me, here, to* Commend *it by any other* Argument, *but this unfrequent one. That the Sage and Upright* Ancients *had* Musick *in so high* Estimation, *as that, when they would fully Characterise a* Learned *and* Sapient *Person, they called him only* ἄνδρα μουσικὸν, *a* Musician: *and, if his long Study of* Humanity

ty *and the* Liberall Sciences *had raiſed Him to* Eminency; *they onely went two Notes higher, and in the ſuperlative degree ſtyled Him* μουσικώτατον, *as if to be well skilled in the* Concordant *and* Diſcordant Proportions *of* Numbers, *were the moſt perfect* Diapaſon *of* Virtue *and* Knowledge. *Thus much, beſides the expreſſe Records of* Plutarch *and* Diogenes Laertius, *may be naturally inferred from hence; that even the beſt of our Moderne* Grammarians, *and* Philologers *derive the word* Muſick, *as alſo the* Muſes, *from the Greeke Verbe,* μάω, *that ſignifies to* Explore with deſire: *and this, upon no ſlender Reaſon; inſomuch as the Key that opens the difficult Locks of all* Arts *and* Sciences, *muſt be an ardent* Deſire of Diſquiſition. *The ſame alſo may bee eaſily Collected from this Conſideration; that to a* Complete Muſitian

(*pleaſe*

(*pleaſe you, to underſtand Him to be ſuch, as hath not only Nibbled at, but ſwallowed the whole* Theory *of Muſick*; i. e. *haveing profoundly ſpeculated the* Pythagorean *Scheme of the various Sounds ariſing from various Hammers, beaten on an Anvill, reſpective to their different* Weights, *doth clearly and diſtinctly underſtand as well the* Arithmetical, *as* Geomtrical *Proportions of* Conſonances, *and* Diſſonances: *for, it is not the mere* Practical *Organiſt, that can deſerve that Noble Attribute*) *is required a more then ſuperficial inſight into all kinds of Humane Learning. For, He muſt be a* Phyſiologiſt; *that He may demonſtrate the Creation, Nature, Proprieties, and Effects of a Natural Sound. A* Philologer, *to inquire into the firſt Invention, Inſtitution, and ſucceding Propagation of an Artificial Sound, or Muſick. An*

Arithme-

Arithmetician, *to be able to explaine the Causes of Motions Harmonical, by Numbers, and declare the Mysteries of the new Algebraical Musick.* *A* Geometrician; *to evince, in great variety, the Original of Intervalls Consono-dissonant, by the Geometrical, Algebraical, Mechanical Division of a Monochord.* *A* Poet; *to conform his Thoughts, and Words to the Lawes of præcise Numbers, and distinguish the Euphonie of Vowells and Syllables.* *A* Mechanique; *to know the exquisite Structure or Fabrick of all Musical Instruments, Winde, Stringed, or Tympanous* aliàs *Pulsatile.* *A* Metallist; *to explore the different Contemperations of Barytonous and Oxytonous, or Grave and Acute toned Metalls, in order to the Casting of tuneable Bells, for Chimes,* &c. *An* Anatomist; *to satisfie concerning the Manner, and Or-*

gans

gans of the Sense of Hearing. A Melothetick; *to lay down a demonstrative method for the Composing, or Setting of all Tunes, and Ayres. And, lastly, He must be so far a* Magician, *as to excite Wonder, with reducing into Practice the Thaumaturgical, or admirable Secrets of Musick: I meane, the Sympathies and Antipathies betwixt Consounds and Dissounds; the Medico-magical Virtues of* Harmonious Notes (*instanced in the Cure of* Sauls *Melancholy fitts, and of the prodigious Venome of the Tarantula*, &c.) *the Creation of Echoes, whether Monophone, or Polyphone,* i. e. *single or Multiplied, together with the Figures of Buildings, and arched Rocks, neer Rivers, Dales, or Woods, requisite to the multiplyed Reverberations of Sounds; the Artifice of Oto-coustick Tubes, or Auriculary Meanders,*

for

for the ſtrengthning, continuation, and remote tranſvection of weake ſounds, and the mitigation of ſtrong; the Model of Autophonous, or ſpeaking Statues; and, finally, the Cryptological Muſick, whereby the ſecret Conceptions of the mind may be, by the Language of inarticulate Sounds, communicated to a Friend, at good diſtance.

Theſe Conſiderations præmiſed; All that can remain to me, as the proper Argument *of this* Præface, *is to advertiſe you, in a word,* (1) *That the many and groſſe* Defects *obſerved in the* Latine *Impreſſion, eſpecialy in the* Figures, *and* Diagramms, *wherein the Evidence of each reſpective Demonſtration ought to have conſiſted; was a principal* Occaſion *to this my* Engliſh *one: which I may juſtly affirme to be ſo* Accurate, *ſome few* Litteral *Overſights of the* Preſs *only excepted, that the Excellent*

Des-Cartes, *had He lived to see it, would have acknowledged the* Translator *for a greater Friend to his Honour, then that rawe* Disciple *of his, who having unfaithfully transcribed the* Original, *and divulged his owne faulty* Copy; *hath often given occasion not only to the Enemies, but also some of the Defendants of his Masters Learned Industry, to suppose, that in this particular Treatise, He write some things more then Himself clearly understood. And* (2) *that the* Authour *of the concise, but weighty* ANIMADVERSIONS *subsequent, long labouring his Thoughts in the strict Examination of the Apodictical Verity of* Des-Cartes, *Fundamentals, in this* Compendium; *most happily lighted on the* Discovery *of a* New Hypothesis, *demonstratively sufficient to the full and easie Solution of all the* Phœnomena *in Musick:*

a Summary whereof, I doe here, as well to prepare, as endear your Attention, præsent you.

All Consonances, *and other Musical* Intervalls *doe arise*

According to Des-Cartes *Principles, from an* Arithmetical *Division of the Chord,* i.e. *by Dichotomising the space of an* Eighth, &c. *as an Eighth from a Bipartition of the whole Line.*

According to others, and the most Judicious Writers on this Subject (such are Mersennus, Lib. de Instrum. Harmonic. i. propos. 15. & Kircherus, in Artis magn. Consoni & Dissoni Lib. 4.) *from the Division of an Eighth* Geometrically, i. e. *into twelve equal* Semitones, *by eleven meane Proportionals.*

But, according to the New *Supposition excogitated by the profound Authour of*

these Animadversions; from the Division of the whole Chord into Extreame *and* Mean Ration, *and of the Mean Ration, according to this Analogie,* Viz.

As the Number of Parts *in the* First *Terme,*
to the Number of Parts in the Third:
So the Number of Rations *between the* First *and* Second,
to the Number of Rations between the Second *and* Third.

Which Novell Invention *alone, is more then enough, on the one side, to give the Capable part of Scholers a gratefull* Relish *of the* Inventors *extraordinary Abilities in the Noblest Member, or Heart of Learning the* Mathematicks: *so also, on the other, to promise an advantageous Compensation of so small an expence of Oyle, as is required*

to

to the comprehenſive peruſal (*not to take notice of the contemptible* Price) *of theſe few* Sheets. *In the Confidence whereof, it is fit I ſurrender you to the pleaſant Leſure and Enjoyment of the* Book *it ſelf.*

A Compendium of Musick.

CHAPTER I.

THE *OBJECT* of this Art is a Sound. The *END*; to delight, and move various Affections in us. For Songs may bee made dolefull and delightfull at once: nor is it strange that two divers effects should result from this one cause, since thus Elegiographers and Tragœdians please their Auditors so much the more, by how much the more griefe they excite in them.

The *MEANS* conducing to this End, or the Affections of a Sound are chiefly two; *viz.* the Differences therof in the reason of Duration or Time, and in the reason of its intension or modification into Acute or Grave; for concerning the quality of a Sound, from what body and how it may procede more gratefull, is the Argument of Physiologists.

This only thing seems to render the voice of Man the most gratefull of all other sounds; that it holds the greatest conformity to our spirits. Thus also is the voice of a Friend more gratefull then of an Enemy, from a sympathy and dispathy of Affections: by the same reason, perhaps, that it is conceived that a Drum headed with a Sheeps skin yeelds no sound, though strucken,

if another Drum headed with a Wolfs skin bee beaten upon in the ſame Room.

CHAP. II.

Præconſiderables.

1. EAch Senſe is capable of ſome Delectation.

2. To this Delectation is required a certain proportion of the object to the ſenſe. Hence comes it, (for inſtance) that the noiſe of Thunder, and the report of Guns are not convenient to Muſick : becauſe they offend the Ear, as the too great ſplendor of the Sun doth deſtroy the ſight.

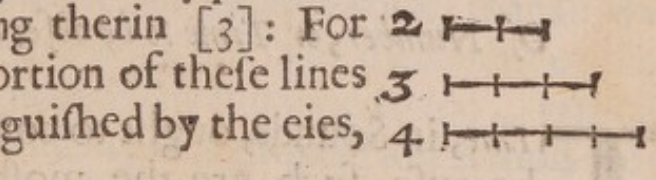
3. The Object muſt bee ſuch, as that it fall not upon the Senſe with too great Difficulty and Confuſion. Hence comes it, (for inſtance) that any Figure exceedingly implicate, though exactly regular, ſuch is the Mother in the Aſtrolabe, is not ſo pleaſant to the Aſpect, as another conſiſting of lines more equall; ſuch as is in the ſame Net : the reaſon wherof is, becauſe the ſenſe doth more fully ſatisfie it ſelf in the one, then in the other, wherin are many things which it doth not perceive ſufficiently diſtinct.

4. That Object is more eaſily perceived by the ſenſe, in which is found the leaſt Difference [1] of Parts. [1]

5. The parts of an Object are ſaid to bee leſſe different each from other, when they mutually hold the greater proportion [2] each to other. [2]

6. That proportion ought to be *Arithmeticall*, not Geometricall. The reaſon wherof is, becauſe, in that, there

there are not so many things advertible, since the Differences are every where equall: and therfore the sense suffers not so much labour and defatigation, that it may distinctly perceive all things occurring therin [3]: For example, the proportion of these lines is more easily distinguished by the eies, then of these



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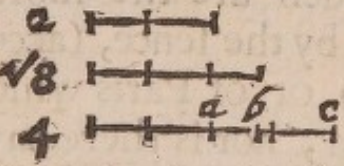


[4]

because in the first, the sense is required only to advert the Unity for the difference of each line; but in the second, the parts AB, and BC, which are incommensurable. And therfore, I conceive, they can by no means be perfectly perceived by the sense, together and at once, but only in order to a proportion *Arithmeticall*; so that it may advert in the part AB two parts, [5] wherof three [6] are existent in BC; wherin it is manifest, that the sense is perpetually deceived.

[5]
[6]

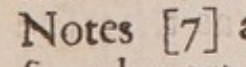
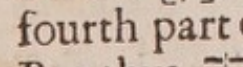
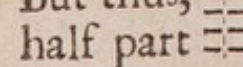
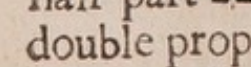
7. Among Objects of the sense, that is not most gratefull to the Mind, which is most easily perceived by the sense; nor that, on the contrary, which is with the most difficulty apprehended: but that which is perceived not so easily, as that that naturall desire, wherby the senses are carried towards their proper Objects, is not therby totally fulfilled; nor yet so hardly, as that the sense is therby tired.

8. Finally, it is to be obserued, that *Variety*, is most gratefull in all things. These Propositions conceded, let us consider the first *Affection* of a Sound.

CHAP. III.

Of Number, or Time to be observed in Sounds.

Time, in Sounds, ought to consist of equall Parts; becauſe ſuch are the moſt eaſily of all others perceived by the ſence, (according to the fourth Præconſiderable:) or of Parts which are in a double or triple proportion, nor is there any further progreſſion allowable; becauſe ſuch are of all others the moſt eaſily diſtinguiſhed by the ear, (according to the fifth and ſixth Præconſiderables.) For, if the meaſures were more unequall, the Hearing could not apprehend their differences without labour and trouble, as experience witneſſeth: For, if againſt one note we ſhould place (for inſtance) five equall ones; it could not be ſung without extream difficulty.

You object, that four Notes may be placed againſt one, or eight; and therefore a farther progreſſion may be made to theſe Numbers. We anſwer, that theſe Numbers are not the firſt among themſelves, and therefore doe not generate new proportions; but only multiply a double: which is conſtant from hence, that they cannot be ſet unleſſe combinated, nor can we ſet ſuch
[7] Notes [7] alone,  where the ſecond is the fourth part of the  firſt:
But thus,  where the laſt ſeconds are the half part  of the firſt, and ſo there is only a double proportion multiplyed.

From theſe two kinds of proportions in Time, there ariſe

ariſe two kinds of Meaſures in Muſick: namely by a Diviſion into Three in time, or into Two. But, this Diviſion is noted by a percuſſion, or ſtroke, as they call it; which is ordained to aſſiſt our Imagination, that ſo we may the more eaſily perceive all the members of the Tune, and be delighted with the proportion, which ought to be in them. Now, this proportion is moſt frequently kept in the members of the Tune, in order to the helping of our Imagination', ſo that while we yet heare the laſt of the time, we may remember what was in the firſt, and what was in the reſt of the Tune. Which is effected, if the whole Tune be compoſed of 8, or 16, or 32, or 64, *&c.* members: ſo that all Diviſions may proceed from a double proportion. For then, when we have heard the Two firſt members, we apprehend them as one, while yet wee conjoyne the Third member with the Firſt, ſo that the proportion becomes triple: afterward, when we have heard the Fourth, we conjoyn it with the Third, and ſo apprehend it as one and the ſame. Then we again conjoyn the Two Firſt with the Two Laſt, and ſo apprehend thoſe Four together as One. And thus doth our Imagination proceed even to the end: where at length it conceives the whole Tune, as one intire thing compoſed of many equall members.

Few have underſtood, how this Meaſure can be exhibited to the ears without a percuſſion, or ſtroke, in Muſick, very diminute and of many voyces. This we ſay is effected only by a certain intenſion of the *Spirit* or breath, in *Vocall* Muſick; or of the *Touch*, in *Inſtrumental*: ſo as from the beginning of each ſtroke, the ſound is emitted more diſtinctly. Which all Singers naturally obſerve, and thoſe who play on Inſtruments; princi-

pally in Tunes, at whose numbers we are wont to dance and leap: for, this Rule is there kept, that we may distinguish every stroke of the Musick, with a single motion of our bodies; to the doing of which we are also naturally impelled by Musick. For certain it is, that a sound doth concusse, or shake all circumjacent bodies, as is exemplified in *Thunder*, and the ringing of *Bells*; the reason whereof is to be referred to the disquisition of *Physiology*. But, insomuch as the *Hoti* is confest by all men, and that the sound is emitted more strongly, and distinctly in the beginning of each Measure, as we have formerly hinted: we may well affirm, that that sound doth more smartly and violently concusse or agitate our Spirits, by which we are excited to motion; as also by consequence, that *Beasts* may dance to number, or keep time with their Feet, if they be taught and accustomed thereto; because to this, nothing more is required, then only a mere naturall *Impetus*, or pleasant violence.

Now, concerning those various Affections, or Passions, which Musick, by its various Measures can excite in us; we say, in the Generall, that a slow measure doth excite in us gentle, and sluggish motions, such as a kind of Languor, Sadnesse, Fear, Pride, and other heavy, and dull Passions: and a more nimble and swift measure doth, proportionately, excite more nimble and sprightly Passions, such as Joy, Anger, Courage, *&c.* The same may be also sayd of the double kind of percussion, *viz.* that a *Quadrate*, or such as is perpetually resolved into equals, is slower and duller, then a *Tertiate*, or such as doth consist of Three equal parts. The reason whereof is, because this doth more possesse and imploy the sence, inasmuch as therein are more (namely 3) members to

be

be adverted, while in the other are only 2. but a more exact & ample disquisition of this rare secret, doth depend upon the exquisite cognition of the *Motions* of the *Minde*; of which this place is uncapable.

However, we shall not omit, that so great is the force of *Time* in Musick, as that it alone can of it selfe adfer a certain *Delectation*; as is experimented in that Military Instrument, the *Drum*, wherein nothing else is required then meerly measure of Time; which therefore (I conceive) cannot there be composed of only 2, or 3 Parts, but also of 5, or perhaps 7 others. For since in such an Instrument the sence hath nothing else to take notice of, but bare Time: therefore in Time may be the greater *Diversity*, that so it may the more exercise and imploy the sence.

CHAP. IV.

Of the Diversity of Sounds, concerning Acute and Grave.

THis may be considered chiefly in three manners, or wayes; either in sounds which are emitted at once and together from divers bodies; or in those which are emitted successively from the same voyce; or lastly, in those which are emitted successively from divers voyces, or sonorous bodies. From the first manner, arise *Consonancies*: from the second, *Degrees*: from the third, *Dissonancies*, which come nearer to Consonancies. Where it is manifest that in Consonancies the Diversity of Sounds ought to be lesse, than in Degrees; because that would more tire, and disgust the Hearing

in

in ſounds, which are together emitted, then in thoſe that are emitted ſucceſſively. The ſame alſo, in proportion, may be affirmed concerning the Difference of Degrees from ſuch Diſſonancies, as are tolerated in relation.

CHAP. V.

Of Conſonancies.

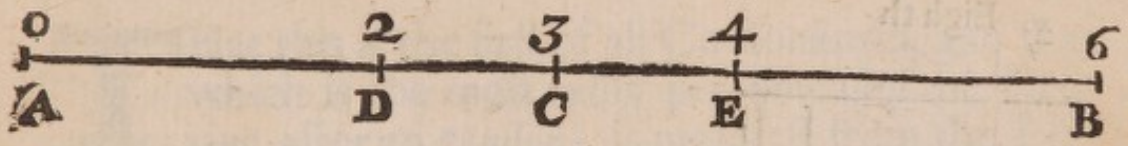
FIrſt, we are to obſerve, that an Uniſon is no Conſonance; becauſe therein is no Difference of Sounds, as to Acute and Grave: but that it bears the ſame relation to Conſonances, that Unity doth to Numbers.

Secondly, that of two Terms, required in Conſonances, that which is the more Grave, is far the more Potent, and doth in a manner contain the other Term in it ſelfe: as is manifeſt in the Nerves of a Lute, of which when any one is percuſſed, thoſe ſtrings, which are an Eighth, or Fifth more acute [8], tremble and reſound of their own accord; but thoſe which are more Grave do not, at leaſt do not appear to the ſence ſo to do; the Reaſon whereof is thus demonſtrated. *One ſound bears the ſame reſpect to another ſound, that one ſtring bears to another ſtring:* but in every ſtring that is greater, all the other ſtrings, that are leſſe, are comprehended; though every ſtring that is longer, doth not comprehend all the others, that are ſhorter: and therfore alſo in every Graver Sound, all others more Acute are comprehended; but not, on the contrary, in every Acuter Sound are the more Grave comprehended: whence it is evident, that

[8]

the

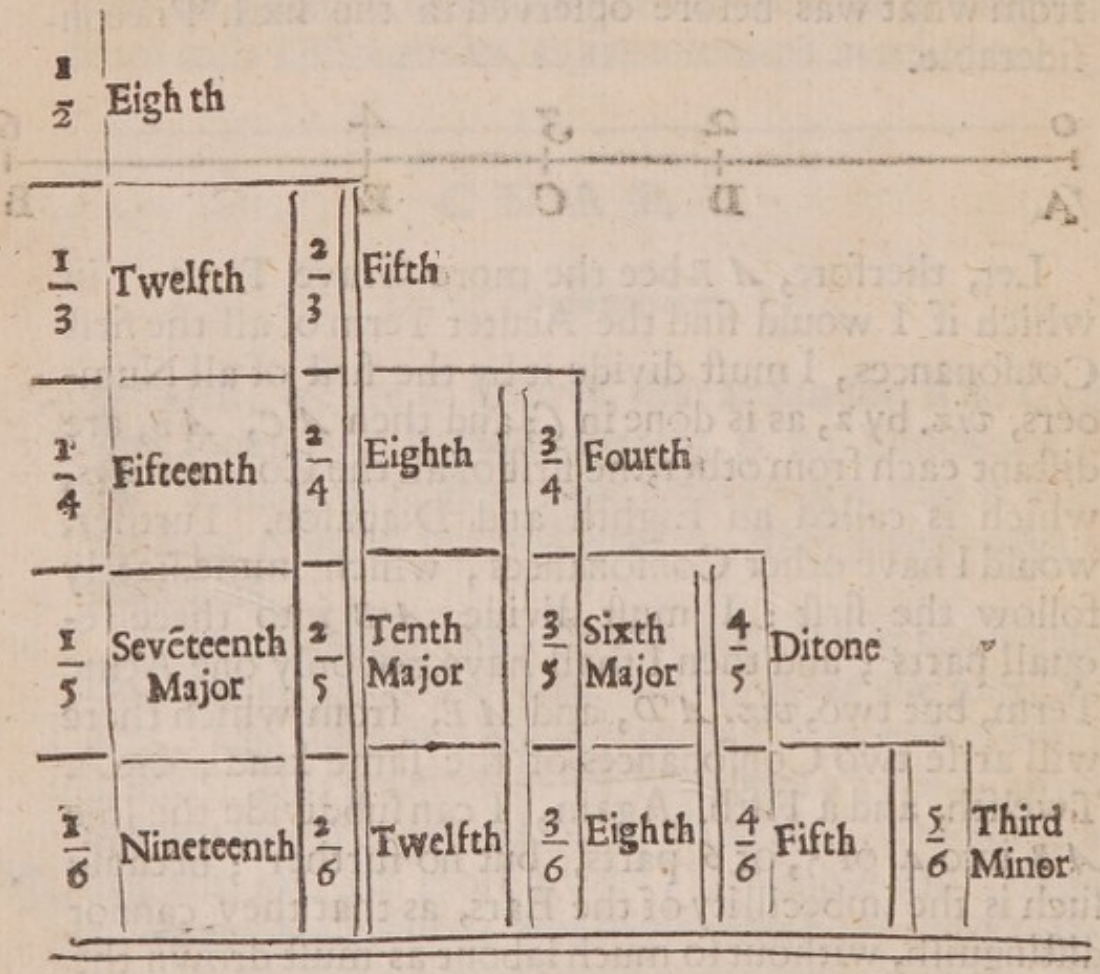
the more Acute Termis to be found by the Diviſion of the more Grave. Which Diviſion that it ought to be Arithmeticall, *i. e.* into equall parts, is conſequent from what was before obſerved in the ſixth Præconſiderable.



Let, therfore, *A B* bee the more Grave Term, in which if I would find the Acuter Term of all the firſt Conſonances, I muſt divide it by the firſt of all Numbers, *viz.* by 2, as is done in *C*; and then *A C*, *A B*, are diſtant each from other, the firſt of all the Conſonances, which is called an Eighth and Diapaſon. Further, would I have other Conſonances, which immediately follow the firſt; I muſt divide *A B* into three equall parts; and then I ſhall have not only one Acute Term, but two, *viz.* *A D*, and *A E*, from which there will ariſe two Conſonances of the ſame kind, *viz.* a Twelfth, and a Fifth. Again, I can ſubdivide the line *A B* into 4, or 5, or 6 parts, but no further; becauſe ſuch is the imbecillity of the Ears, as that they cannot diſtinguiſh, without ſo much labour as muſt drown the pleaſure, any more Differences of Sounds [9]. [9]

Heer we are required to note, that from the firſt Diviſion doth ariſe only one Conſonance: from the ſecond, two: from the third, three: as this Table demonſtrateth [10]. [10]

First Figure.



Heere wee have not ſet downe all Conſonances that are; in regard, that, to our more facile Invention of the reſt, requiſite it is that we firſt treat

CHAP.

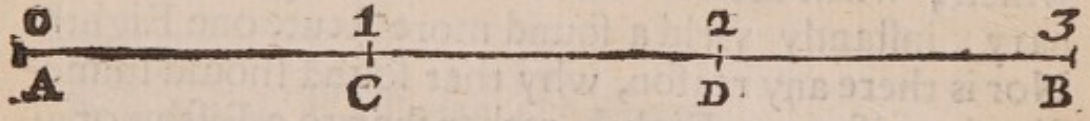
CHAP. VI.

Of an Eighth.

THat this is the first of all Consonances, and that which is the most easily perceived by the Hearing after an *Unison*; is manifest from the Premises, and also comprobated by experiment in Pipes: which, when blown with a breath stronger than ordinary, instantly yield a sound more Acute one Eighth. Nor is there any reason, why that sound should immediately arise to an Eighth, rather than to a Fifth, or any other Note; unlesse because an Eighth is the first of all Consonances, and that which is the least different from an Unison. From whence, we conceive, it doth also follow, that no sound can be heard, but it seems in some sort to resound in the ear more Acute an Eighth: and that this is also the cause, why in a Lute to the greater strings, which give Graver sounds, other smaller strings more Acute one Eighth are consociated, which are alwayes percussed at the same instant, and so effect that the Graver sounds are heard more distinctly. Whence it is manifest, that no sound which shall be consonant to one Term of an Eighth, can be dissonant to any other Term of the same Eighth.

A *second* thing to be observed concerning an Eighth, is this; that it is the greatest of all Consonancies, that is, that all other Consonancies are contained therein; or composed [11] therof, and of others which are contained [11] therein. Which may be demonstrated from hence, that

all Consonancies consist of equall parts [12]; whence it comes, that if their Terms be more distant each from other than one Eighth, we may, without any further Division of a more Grave Term, adde one Eighth to a more Acute, of which, together with the residue, it will appear that that is composed [13]. An Example may be *A B*, divided into three equall parts, of which *A C*, *A B*, are distaut by one Twelfth: we say, that Twelfth is composed of an Eighth, and the residue thereof, *viz.* a Fifth [14]; for composed it is of *A C*, *A D*, which is



an Eighth; and *A D*, *A B*, which is a Fifth: and so it falls out in the rest. Whence it comes, that one Eighth doth not so multiply the numbers of proportion if it compose others, as all others do; and is therefore the only Consonance which is capable of *Gemination*, or Doubling. For, if it be Geminated, it makes only 4 [15], or 8, if regeminated: but if a Fifth be Geminated, which is the First after an Eighth, it makes 9 [16]: for from 4, to 6, is a Fifth; in like maner from 6, to 9; which number is far greater then 4, and exceeds the series of the first six Numbers, in which we have formerly included all Consonances [17].

From this it naturally follows; that of all Consonancies, of what kind soever, there are but three Species: one is Simple: another Compound of a Simple and an Eighth: a third composed of a simple and 2. Eighths. Nor can any other Species be added, which is composed of 3 Eighths, and another simple Consonance; because these are the extream limits, nor is there

there any progreſſion beyond three Eighths; ſince then the numbers of Proportions would be multiplyed exceſſively. From whence is deduced a generall Catalogue of all Conſonances whatever, which is here preſented in the following Table.

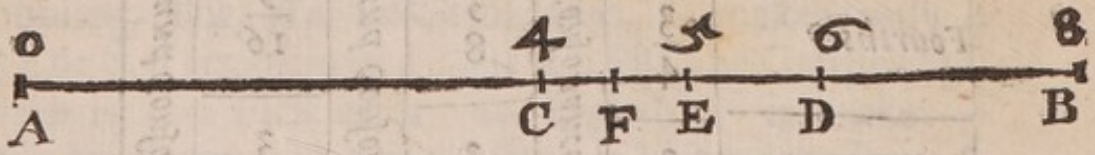
Second Figure.

	Simple Conſonances.	First Compound Conſonances.	Second Compound Conſonances.
Eighths	1/2	1/4	1/8
Fifths	2/3	1/3	1/6
Ditones	4/5	2/5	1/5
Fourths	3/4	3/8	3/16
Sixths majors	3/5	3/10	3/20
Thirds minors	5/6	5/12	5/24
Sixths minors	5/8	5/16	5/32

Here have we added the *Sixth Minor*, which we had not obſerved in the precedent Chapter; in regard it may be educed from what hath been ſayd of an Eighth, from which if a Ditone be cut off, the remainder will
[18] be a Sixth Minor [18]. But of this more clearly anon.

Wheras we even now affirmed, that all Conſonances
[19] were comprehended in an Eighth [19]; we are concerned to inquire how that comes to paſſe, and how they proceed from the Diviſion thereof, that ſo their nature may be the more plainly and diſtinctly underſtood.

Firſt, it is moſt certain, that that Diviſion of an Eighth, from which all Conſonances ariſe, ought to be Arithmeticall, or into equall parts: now what that is, which ought to be divided, is evident in the ſtring *A B*, which is diſtant from *A C*, the part *C B*; but the



ſound *A B*, differs from the ſound *A C*, an Eighth: therefore will the ſpace of an Eighth be the part *C B*. That therefore is it, which ought to be divided into two equalls, that the whole Eighth may be divided, which
[20] is effected in *D* [20]. From which Diviſion, that we may underſtand what Conſonance is properly, and *per ſe* generated; we are to conſider that *A B*, which is the more grave Term, is divided in *D*, not in order to it ſelf, for then it would have been divided in *C*, as was done before: nor, as the Caſe ſtands now, is an Uniſon divi-

ded,

ded, but an Octave, which consists of two Terms, and therefore when the more Grave Term is divided, that Division is made in order to another more Acute. Whence it comes that the Consonance properly arising from the Division, is between the Terms *A C*, *A D*, which is a Fifth; not betwixt *A D*, *A B*, which is a Fourth: because the part *D B*, is only the residue, and generates a Consonance by accident; from hence, that sound which makes a Consonance with one Term of an Eighth, ought also to make a Consonance with the other.

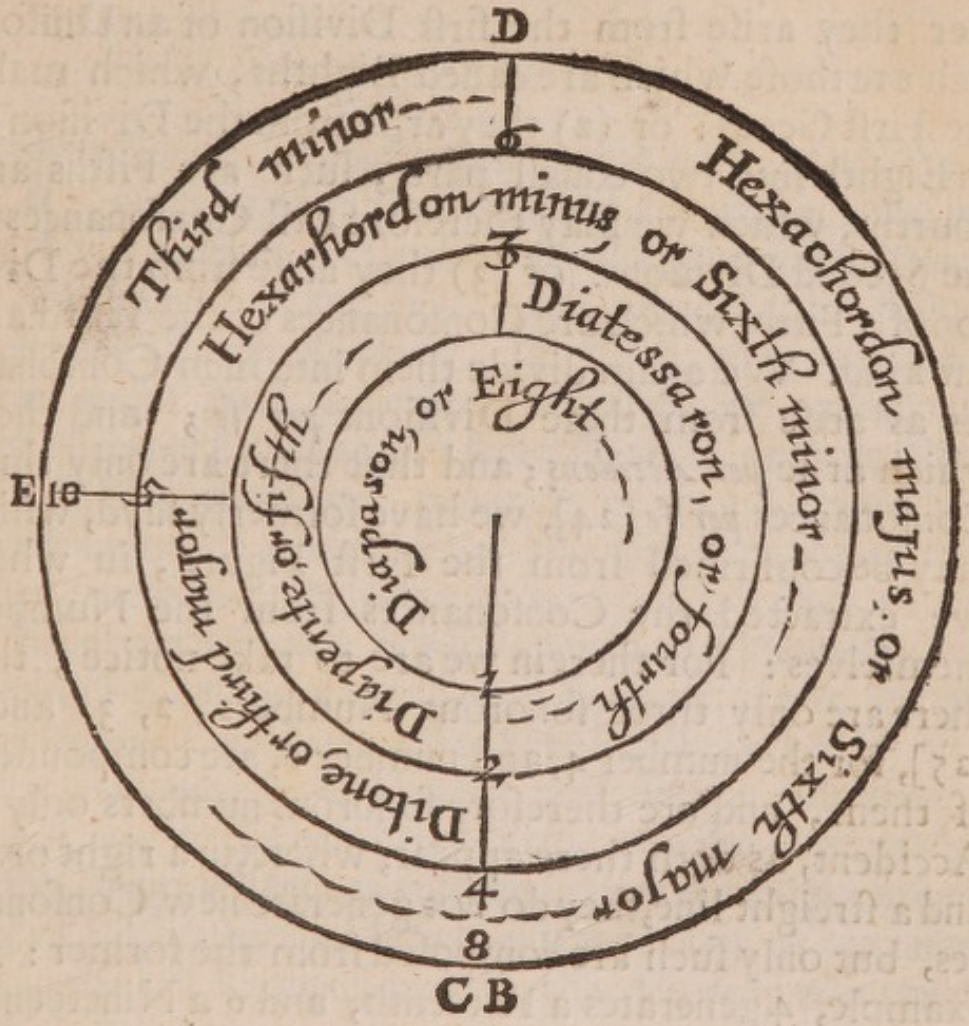
Again, the space *C B* being divided in *D*, I might by the same reason divide *C D* in *E* [21]; from whence a Ditone would be directly generated, and by accident all the other Consonances: nor is it requisite that *C E* be further divided; yet if that were done, *viz.* in *F* [22], then would from thence arise a greater Tone, and by accident a lesser Tone, and the Semitones [23], of which hereafter: for, in a voyce, they are successively admitted, but not in Consonances. [21] [22] [23]

Nor let any think it imaginary, what we say, that only a Fifth and a Ditone are generated from the Division of an Eighth properly, and all other Consonances by Accident; for Experience teacheth the same in the strings of a Lute or other Instrument, whereof if one be stroke, the force of that sound will strike all the other strings which shall be more Acute in any kind of Fifth or Ditone: but in the others which are distant a Fourth, or other Consonance, the same shal not happen. Which force of Consonances must undoubtedly arise from hence

hence, either from their Perfection, or Imperfection, insomuch as these are first Consonances of themselves, but all others are only by Accident, because they necessarily flow from others.

But let us enquire, whether that be true, which we formerly sayd, *Viz.* That all Simple Consonances are comprehended in an Eighth: this we shall easily justifie, if we shall turn *CB*, the halfe of *AB*, which contains an Eighth, into a Circle; so that the poynt *B* may be joyned to the poynt *C*. Then let the Circle be divided in *D* and *E*, as it was divided in *CB*: and the reason why all the Consonances ought so to be found out, is because no sound can be consonant to one Term of an Eighth, but it must also be consonant to the other Term of the same, as we have already proved. From whence it comes, that if in the subsequent Figure one part of the Circle make a Consonanee; the residue must also contain some Consonance.

Third Figure.



From this Figure it is demonstrated how rightly an Eighth is named Diapasson, because it comprehends in it selfe all the intervalls of other Consonances. Here we have exhibited only Simple Consonances; where if we would find out also Compound ones, all we are to do is only to adde, to the intervalls above described, one or two whole Circles; and then it will appear that an

Eighth doth compose all Consonances.

From what hath præceded, we collect that all Consonances may be referred to Three Kinds; for (1) either they arise from the first Division of an Unison, such are those which are called Eighths, which make the First Genus: or (2) they arise from the Division of an Eighth into two equall parts, such are Fifths and Fourths, which we may therefore call Consonances of the Second Division: or (3) they arise from the Division of a Fifth, which are Consonances of the Third and last kind. We again divide them into such Consonances as arise from those Divisions *per se*; and those which arise *per Accidens*; and that there are only three
[24] Consonances *per se* [24], we have formerly sayd, which may be confirmed from the First Figure, in which we extracted the Consonances from the Numbers themselves: For therein we are to take notice, that there are only three sonorous Numbers, 2, 3, and 5
[25] [25], for the number 4, and number *6*, are compounded of them, and are therefore sonorous numbers only by Accident, as doth there appear; where, in a right order and a streight line, they do not generate new Consonances, but only such are composed from the former: for example, 4 generates a Fifteenth, and *6* a Nineteenth; but *per Accidens* and in a transvers line, 4 generates a Fourth, and *6* a Third lesser; where we are to observe by the By, that in the Number 4, a Fourth is immediately generated from an Eighth, and is in a manner a certain Monster, or difficient and imperfect Product of an Eighth [*26*].

CHAP.

CHAP. VII.

Of a Fifth.

THis, of all Conſonances, is the moſt gratefull, and acceptable to the Ear; and, for that reaſon, it is the prime and ruling Conſonance in all Tunes; as alſo from it do the *Modes* [27] proceed, as follows from the 7 *Præconſiderable*: for ſince, as it is manifeſt from what hath preceded, whether we extract the perfection of Conſonances from *Diviſion*, or from *Numbers* [28]; there can properly be found only three Conſonances, among which the fifth hath the middle place: this (certainly) is it which reſounds in the ears not ſo ſharply as a *Ditone*, nor ſo languid as a *Diapaſſon*, but the moſt pleaſant of all others. Further, from the *Second Figure* it appears, that there are three kinds of a Fifth [29], where the Twelfth poſſeſſes the mean place, which we may therefore affirm to be the moſt perfect Fifth: from whence it follows, that we might uſe no other Conſonance in Muſick, if it were not, as we inferred in the laſt Præconſiderable, that Variety was neceſſary to *Delectation*.

[27] [28] [29]

If it be objected, that, in ſome caſes, an Eighth may be ſet alone in Muſick, without any Variety; as, for Example, when two voyces ſing the ſame Tune, one more acute than the other in an Eighth: but the ſame doth not evene in a Fifth; and therefore it follows, that an Eighth ought to be accounted the moſt gratefull of all Conſonances, rather than a Fifth.

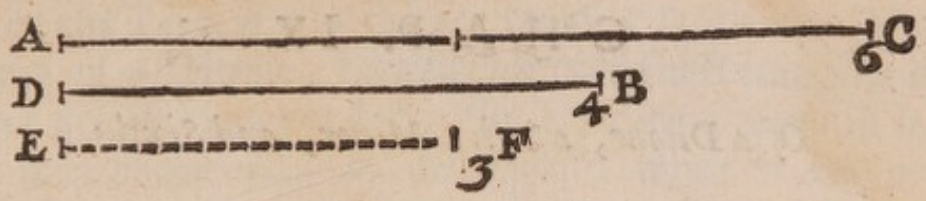
We answer, that, from this Instance, our Assertion is rather confirmed, than infirmed; for the reason, why an Eighth may be so set, is, because it comprehends an Unison in it selfe, and so those two voyces resound in the eare as one; which happens not in a Fifth, whose Terms are more different among themselves, and therefore possesse, and exercise the Hearing more fully; from whence a certain wearinesse and loathing would arise forthwith, if it were set alone, and without Variety in Tunes. This may be exemplified thus; we should be sooner weary if we were constantly fed with Sugar, and Sweat-meats, than if with bread alone; which every man will allow not, in any proportion, comparable for sweetnesse and blandishment of the palate, to Sugar.

CHAP. VIII.

Of a Fourth.

THis, of all Consonances, is the most unhappy; nor is it ever used in Tunes, unlesse by Accident, and with the assistance of others: not that it is more imperfect than a Third Minor, or a Sixth, but that it approacheth the nature of a Fifth so neerly, that the grace of this is drowned in the sweetnesse of that. To the understanding of which, we are to note, that a Fifth is never heard in Musick, but that, in some sort, an acuter Fourth is withall advertised; which follows from what we have sayd [30], that in an Unison, there is, in some sort, resounded an acuter Eighth. For Example, let

let *AC* be in distance form *DB* oFi dne the reso-



nance thereof, more Acute by an Eighth, be *EF*; and certainly that will be distant from *DB*, by one Fourth: whence it comes, that it may be called the shadow of a Fifth, which perpetually accompanies it; and thence also it is evident, why a Fourth cannot be set in Tunes, primarily, and *per se*, *i. e.* betwixt a Basse and another part. For when we sayd, that other Consonances were necessary in Musick, only in order to the variation of a Fifth; certainly, it is evident, that a Fourth would be useleſſe, in regard it cannot vary a Fifth: which appears from hence; that, if it were set in a more Grave part, it would alway resound more Acute than a Fifth, where the Hearing would soon perceive that it is deturbed from its proper place to an inferiour one, and so a Fourth would bee most harsh and unpleasant thereto, as if only the shadow were presented instead of the body, or the Image objected instead of the Thing it selfe.

CHAP. IX.

Of a Ditone, a Third Minor, and Sixths.

THat a *Ditone* is, by many degrees, more perfect than a Fourth, is manifest from the Premises; to which, nevertheless, we shall adde this; that the Perfection of any Consonance is not to be desumded precisely, from the same, while it is Simple; but also from all the Compounds thereof: the reason whereof is, that it can never be heard alone so jejune and empty, but the resonance of this composed is also heard together with it; since that, in an Unison, the resonance of a more Acute Eighth is contained, we have formerly evicted. Now, that a Ditone, so considered, doth consist of lesser Numbers than a Fourth [31], and is therefore more perfect than a Fourth; is plain from the *Second Figure*: wherein we, therefore, placed a Ditone before a Fourth, insomuch as we endeavoured, in that Figure, to place all Consonances according to the order of Perfection.

[31]

But here we are obliged to explain, why the third *Genus* of a Ditone is the most perfect, and makes, in the strings of a Lute, a Tremulation perceptible even by the sight; rather than the First, or Second Genus: which we conceive to proceed from hence; that this Third doth consist in a *multiplyed Proportion*, but the First in a super-particular, the Second in a multiplyed and super-particular, together [32]. And why, from multiplyed proportion, the most perfect Consonances do arise; which we therefore placed in the First order of the

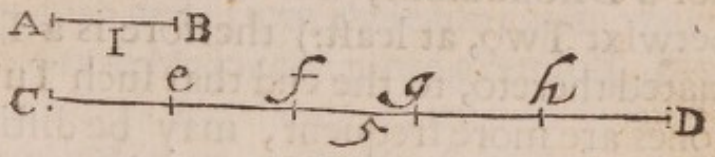
[32]

First

First Figure, we thus demonstrate.

Let the Line *A B* be distant from *C D*, in the Third Genus of a Ditone, howsoever men shall imagine the sound to be perceived by the Hearing; certain it is that it is more easie to distinguish what is the pro-

For Example,



portion betweene *A B* and *C D*, than betweene *C F* and *C D*; beeause it will first bee knowne directly by the application of the sound *A B*, to the parts of the sound *C D*, *viz. C e*, *e f*, *f g*, *&c.* nor will there be any residue in the end: which falls not alike in the proportion of the sound *C f*, to *C D*; for if *C f* be applyed to *f h*, there will be the residue *h D*, by the reflection of which we ought to know what is the proportion between *C f* & *C D*, which is more difficult or tedious. By the same way will it be conceived, if any say that a sound doth strike the ears with many percussions or verberations, and that by so much the more swiftly, by how much the more acute the sound is; for then, that the sound *A B* may arrive at the requisite Uniformity with the sound *C D*, it ought to strike the ears with only five touches or verberations, while *C D* strikes only once: but the sound *C f* will not so soone returne to an Unisonance, for that cannot be done but after the second stroke of the sound *C D*, as is described in the superiour Demonstration. The same will also be explained, however we conceive the sound to be heard.

A *Third Minor* ariseth from a Ditone, as a Fourth from a Fifth [33], and is therefore more imperfect than [33]

a Fourth, as a Ditone, is than a Fifth. Nor is it therefore to bee excluded Muſick, ſince it is not onely not uſeleſſe, but even neceſſary, in order to the variation of a Fifth. For, ſince an Eighth is alwayes heard in an Uniſon, it cannot adfer this variety; nor a Ditone alone, (for there can be no variety unleſſe betwixt Two, at leaſt:) therfore is a Third Minor aſſociated thereto, to the end that ſuch Tunes, wherein Ditones are more frequent, may be diſtinct from ſuch as have a Third Minor very often iterated in them.

A *Sixth Major* proceeds from a Ditone, and by the ſame reaſon participateth the nature thereof, as a Tenth Major, and Seventeenth [34]: to the underſtanding of which, we are to look back upon the Firſt Figure, where, in the number Foure, are found a Fifteenth, an Eighth, and a Fourth, which is the Firſt Compound Number, and which, by a Binary, (which repreſenteth an Eighth,) is reſolved even into an Unity; whence it comes that all Conſonances generated from it, are apt and convenient for Compoſition, among which ſince a Fourth is found, (which, for that reſpect, we formerly called a Monſter, or defective Eighth;) thence doth it follow, that the ſame is not unprofitable in compoſition, where the ſame reaſons do not recur, which hinder it from being ſet alone; for then is it perfected by the adjunct, and remains no longer ſubject to a Fifth, [34]

A *Sixth Minor* proceeds from a Third Minor, in the ſame manner as a Sixth Major doth from a Ditone [35], and ſo borrows the nature and affections of a Third Minor: nor is there any reaſon to countermand it. [35]

Here the Series of Conſonances would Exact from us a Diſcourſe concerning their various *Virtues*, as to the excitement

excitement of *Passions:* but a more exact Disquisition of this, may be collected from the Præcedents; and it exceeds the limits of a *Compendium.* For, so various are they, and upon so light circumstances supported; that, a whole Volume would not suffice to perfect their Theory. This, therefore, shall we only say, that the chiefest Variety doth arise from these four last; whereof a Ditone and Sixth Major are more gratefull, more sprightfull, and exhilarating than a Third and Sixth Minor; as hath been observed by *Practicall Musicians*, and may be easily deduced from hence, that a Third Minor is generated from a Ditone only by Accident, but a Sixth Major *per se*, because it is no other but a Ditone Compound.

CHAP. X.

Of Degrees, or Tones Musicall.

FOr two causes chiefly are Degrees required in Musick; (1) That by their assistance a Transition may be made from one Consonance to another, which cannot, so conveniently, be effected by Consonances themselves with Variety, the most gratefull thing in Musick: (2) That all that space, which the sound runs over, may be so divided into certain intervals, as that the Tune may alwayes passe through them more commodiously than through Consonances.

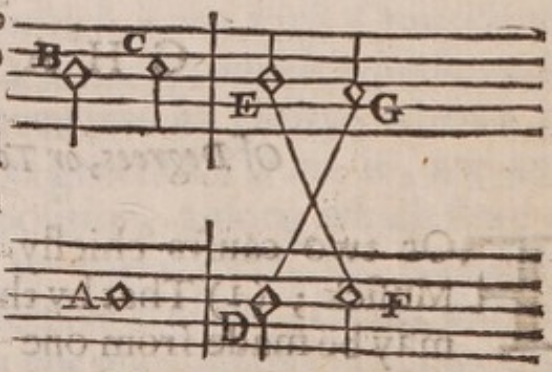
If we consider them in the first capacity; there can be only Four kinds of Degrees, and no more: For then they ought to be desumed from the inequality, found

between Consonances, and all Consonances are distant each from other $\frac{1}{9}$ part, or $\frac{1}{10}$, or $\frac{1}{16}$, or finally $\frac{1}{21}$ [36]; besides the intervals which make other Consonances: therefore all Degrees consist in those numbers, the two first Tones whereof are called Major and Minor, and the two last are called Semitones, Major and Minor. But we are to prove that Degrees, considered in this capacity, are generated from the inequality of Consonances; which is thus done. So often as there is a transition made from one Consonance to another, either one Term is moved single, or both together; and by neither of these two ways can any such transition be made, unless by those intervals, which design the inequality betwixt Consonances: Therefore. The first part of the Minor is thus demonstrated.

[36]

[37] Let from *A* to *B*, be a Fifth; and from *A* to *C*, be a Sixth Minor; and, of necessity, from *B* to *C* wil be that difference, which is betwixt a Fifth and a Sixth Minor, *viz.* $\frac{1}{16}$, as is evident [38]: but that the Posterior part of the Minor may be proved, wee are to observe; that wee are not, in sounds, to regard only the proportion while they are emitted together, but also while they are emitted successively, so that, as much as possible, the sound of one Voyce ought to keepe Consonance with the immediately præcedent sound of the other voyce; which can never bee effected, if the Degrees did not arise from the inequality of Consonances. For Example, let *D E* be a Fifth, and let each Term be moved

[37]



[38]

moved by contrary motions, so that a Third Minor may be created; if *D F* be an intervall, which doth not arise from the inequality of a Fourth to a Fifth, *F* cannot, by relation, be consonant to *E*; but if yea, then it can: and so likewise in the rest, as may soon be experimented. Here observe, that as concerning that Relation, we sayd it ought to be consonant so much as possible: for alwayes it cannot be, as will appeare in the succeeding Discourse.

But if wee consider them in the second Capacity; namely, how these Degrees may, and ought to bee ordained in the whole intervall of sounds, that by them one solitary voyce may be immediately elevated, or depressed; then, among the Tones already found out, those Degrees shall only be accounted Legitimate, into which the Consonances are immediately divided. To the manifestation of this, wee are to advert, that every intervall of sounds is divided into Eighths, whereof one can by no means differ from another, and therefore that it is sufficient, if the space of one Eighth be so divided as that all the Degrees may be obtained: as also, that that Eighth is already divided into a Ditone, a Third *minor*, and a Fourth [39], all which evidently follow from what wee have sayd concerning the last Figure of the Superior Tractate. [39]

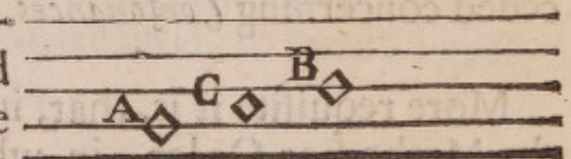
Hence also is it manifest, that Degrees cannot divide a whole Eighth, unless they divide a Ditone, a Third *minor*, and a Fourth; which is thus done. A Ditone is divided into a Tone *major*, and a Tone *minor* [40]; a Third *minor* is divided into a Tone *major*, and a Semitone *majus* [41]; a Fourth, into a Third *minor*, and also a Tone *minor* [42], which Third is again divided into a [40] [41] [42]

Tone *major*, and a Semitone *majus* [43]; and so the whole Eighth doth consist of three Tones *major*, two Tones *minor*, and two Semitones *majora*; as is manifest to him who seriously and exactly perpends their Scheme. And here we have only three Kinds of Degrees; for a Semitone *minus* is excluded, because it doth not immediately divide Consonances, but only a Tone *minor*. As for Example, if it be sayd that a Ditone doth consist of a Tone *major*, and both Semitones [44] (for both Semitones compose a Tone *minor* [45]): but wherefore, will you say, is not that Degree also admitted, which resulteth from the Division of another, and divides Consonances onely *Mediately*, not immediately? our Answer is, that the Voyce cannot run through so many various Divisions, and at the same instant be consonant with an other different voyce, unless with extream Difficulty, as is open to Experiment: besides, a Semitone *minus* would then be joyned to a Tone *major* [46], with which it would create a most unpleasant Dissonance; for consist it would between these numbers 64 and 75 [47], and therefore the voyce could not bee moved through such an intervall. But, in order to the clearer solution of this Objection, we are to note;

That to the Creation of an Acute sound, is required a more forcible emission of the breath, or spirit in vocall Musick; or a stronger percussion of the strings in instrumentall; than is required to the Creation of a Grave: which is experimented in the strings of a Lute, which yield a sound by so much the more Acute, by how much the more they are distended; as also from hence, that by a greater force, the Aer is divided into lesser parts, from which the more Acute sound must of

necessity

neceſſity be generated: and from hence it is a direct Conſequence, that by how much the more Acute a ſound is, by ſo much the more ſtrongly doth it ſtrike the eares. From this animadverſion, I conceive, a true and chiefe reaſon may be rendred, wherefore *Degrees were invented; viz.* leaſt, if the voyce ſhould run through the Termes of Conſonances alone, there would bee among them too great a diſproportion in the reaſon of intenſion, which would inevitably tire both the Auditors and Singers. For Example, would I aſcend from *A* to *B*, becauſe the ſound *B* wil ſtrike the ears far ſtronger, than the ſound *A*, leſt that Diſproportion ſhould be incommodious, the Term *C* is ſet in the midle, by which we may, as by a Degree, more eaſily, and without that inequall contention of the breath, aſcend to *B*. From which it is manifeſt, that Degrees are nothing elſs but a certaine *medium*, interpoſed betweene the Terms of Conſonances, for the moderation of their inequality; and that of themſelves they have not ſweetneſſe enough to ſatisfie the ears, but are only conſiderable and uſefull in order to Conſonances; ſo that while the Voyce runs through one Degree, it leaves the Hearing unſatisfied, untill it ſhall have arrived at a Second; which, for that reſpect, ought, together with the former Degree, to conſtitute a Conſonance: and this is ſufficient to ſolve the præcedent Objection. Moreover, this alſo is the reaſon, why, in a Voyce, ſucceſſively Degrees are admitted, rather than Ninths or Sevenths, (which ariſe from Degrees,) or others which do conſiſt of leſſe Numbers than Degrees; namely, becauſe intervals of this ſort do not



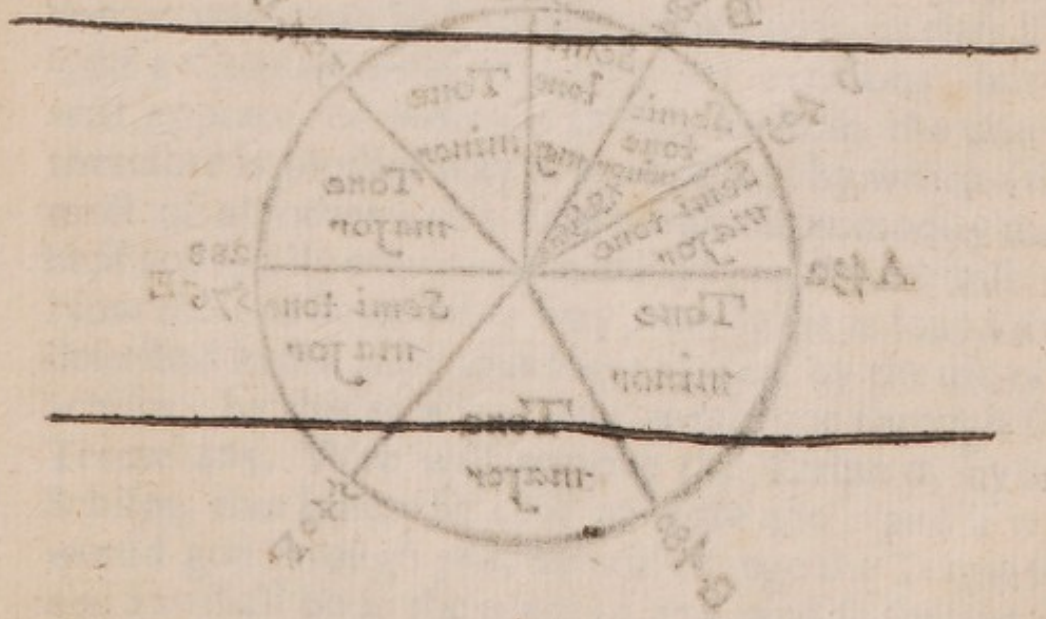
divide the least Consonances, nor can they therfore moderate that inequality, which is betwixt their Terms. More, concerning the invention of *Degrees*, (which arise from the Division of a Ditone into two parts, as a Ditone doth from the Division of a Fifth,) might be superadded; and many things from thence be deduced, which concern their sundry *Perfections*: But it would require more room than a *Compendium* can afford, and a good Understanding may infer as much, from what hath præceded concerning *Consonances*.

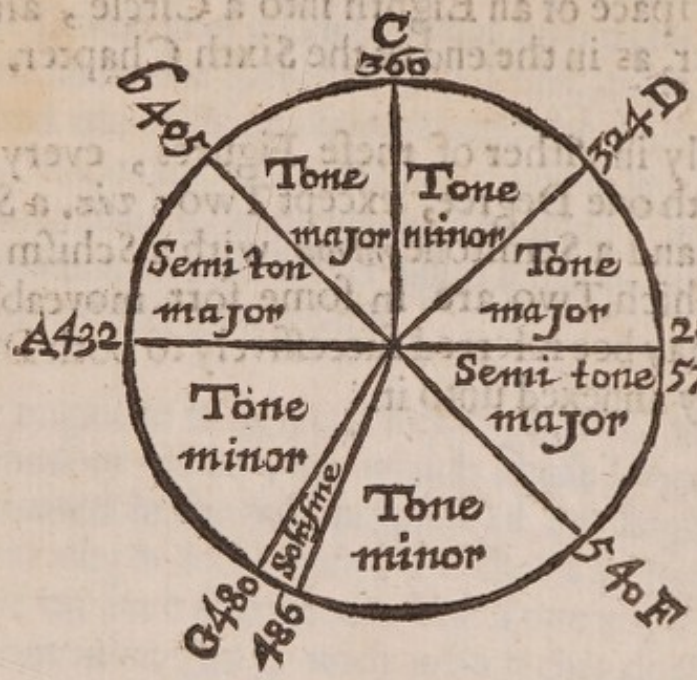
More requisite it is, that, in the present, we speak of the Method or Order, in which those Degrees are to be constituted in the whole space of an Eighth; now this Order ought to be such, as that a Semitone *majus*, [48] may have on each side next to it a Tone *major* [48]; as [49] also a Tone *minor* [49], with which this doth compose a Ditone; and the Semitone a Third *minor*, according [50] to what we have just now observed [50]: but since an Eighth containeth Two Semitones, and as many Tones *minor*; that this may be obtained without Fraction, it [51] ought also to containe Foure Tones *major* [51]: Now because it containes only three, therefore is it necessary, that, in some place, wee use a certaine Fraction, which may be the difference betwixt a Tone *major* and a Tone [52] *minor*, which we nominate a *Schism* [52]; or also between a Tone *major* and a Semitone *majus*, which con- [53] tains a Semitone *minus* with a *Schism* [53]: to the end, that by the helpe of these Fractions the same Tone *major* may, after a sort, bee made moveable, and so perform the office of two Tones; which is easily preceptible

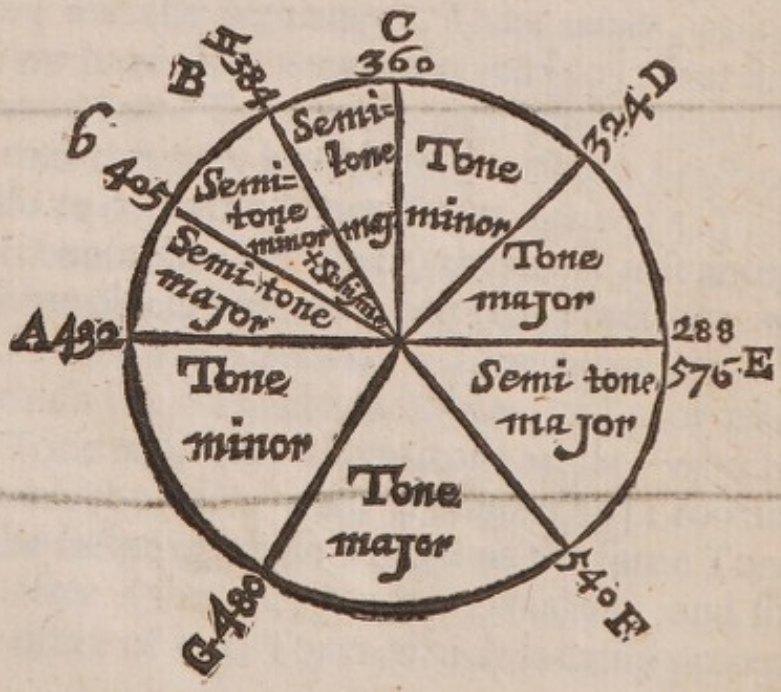
in

in the Figures here delineated, where we have turned the whole ſpace of an Eighth into a Circle, after the ſame manner, as in the end of the Sixth Chapter.

And truely in either of theſe Figures, every intervall deſigneth one Degree, except Two: *viz.* a Schiſm in the Firſt, and a Semitone *minus* with a Schiſm in the Second: which Two are in ſome ſort moveable, ſo that they may bee referred ſucceſſively to both Degrees immediately annexed unto it.




C
360
324 D
288
576 E
540 E
480 G
486
432 A
405 b
Tone major
Tone minor
Tone major
Semi tone major
Tone minor
Tone minor
Semitone minor
Semi tone major


C
360
384 B
324 D
288
576 E
540 E
480 G
432 A
405 b
Semi tone
Tone major
Semi tone major
Tone minor
Tone major
Semi tone major
Tone minor
Tone major

Now,

Now, manifeſt it is from theſe Figures, (1) That, in the Firſt Figure, there can be no aſcention by Degrees from 288 [54] to 405, unleſſe wee emit the midle Term in ſome ſort tremulous or quavering; ſo that if it reſpect 288, it may ſeeme to bee 480, but if it reſpect 405, then it may ſeeme to bee 486, *viz.* that with both it make a Third *minor*, and the difference is ſo ſmal betwixt 480 and 486, that the mobility of that Terme, which is conſtituted from both, doth not ſtrike the Hearing with a Diſſonance perceptible. [54]

(2) In the Second Figure, after the ſame reaſon, we cannot aſcend from the Term 480 to 324, by Degrees; unleſſe wee ſo expreſſe the midle Terme, as that, if it reſpect 480, it may ſeem 384; if it reſpect 324, it may be 405, that ſo, with both, it may make a Ditone. But becauſe betwixt 384 and 405, the difference is ſo great, that no voyce can be ſo tempered of them, as that if it hold a Conſonance with one of the extreams, but it will appeare exceedingly Diſſonant from the other: therefore is another way to bee ſought, by which (the moſt of all others) this ſo great an incommodity may be, if not totally removed, yet at leaſt greatly diminiſhed. Now this can be no other way, but what is found and deſcribed in the Superiour Figure, *viz.* by the uſe of a Schiſm: by this means, if wee would goe through the Terme 405. Wee will remove the Terme *G*, by one Schiſm, that it may be 486, no more 480: and if wee would goe through 384, we will change the Terme *D*, and 320 ſhall be in the place of 324, and ſo ſhall be diſtant, by a Third *minor*, from 384.

From theſe conſiderations it is evident, that all the ſpaces, through which one voyce ſolitary may bee moved, are contained in the Firſt Figure: for, when the incommodity of the Second Figure is corrected, then doth it not differ from the Firſt [55]; as is eaſily deprehended.

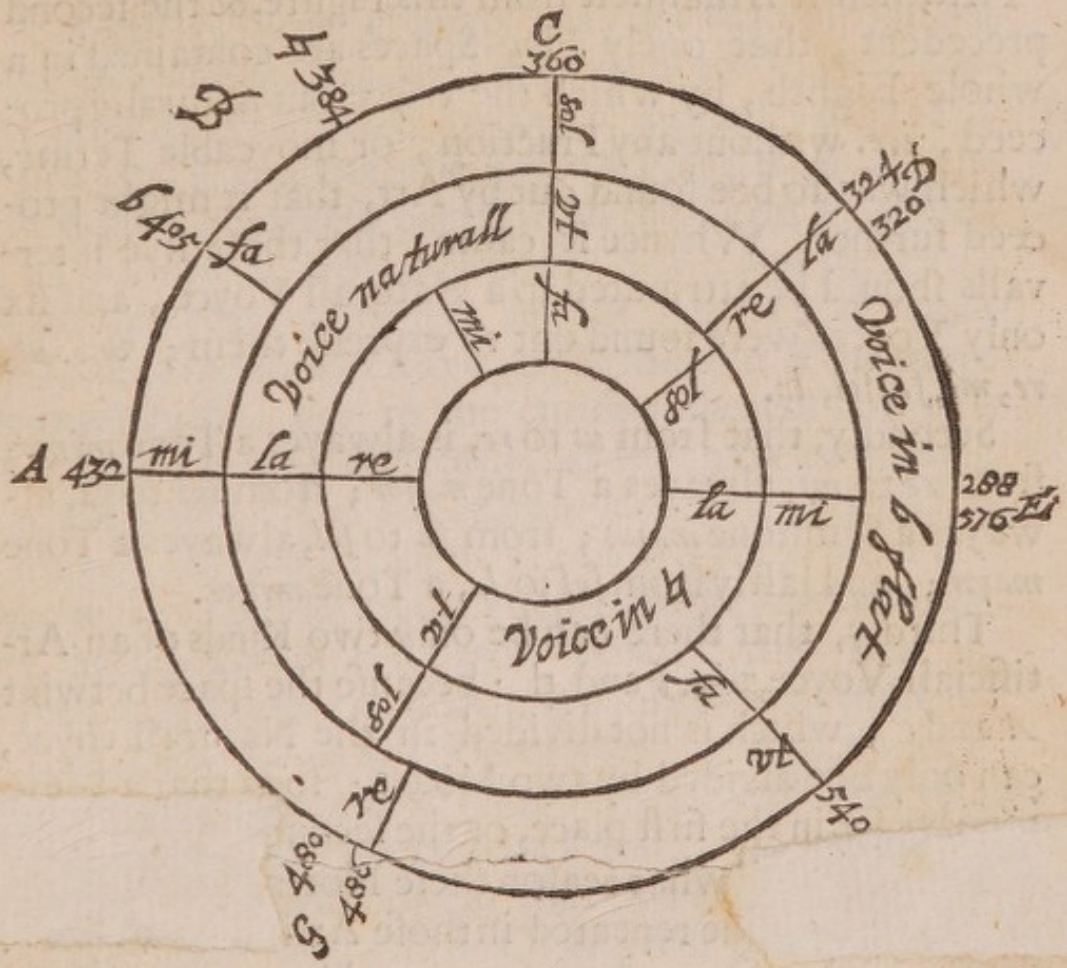
Evident it is alſo, that that Order of Tones, which practicall Muſitians call the *Hand*, doth contain all the Modes, by which Degrees may be ordained; for, that they are comprehended in the two præcedent Figures, is formerly proved: and that Hand of Practicall Muſicians doth contain all the Termes of each Precedent Figure, as is eaſily diſcerned in the following Figure, in which we have turned that Hand, into a Circle, that ſo it might the better be referred to the Superiour Figures. Yet, to the underſtanding of this Figure, we are to ſignifie, that it begins from the Term *F*, where, for that cauſe, we have applyed the greateſt number, that thence it might be collected that that Term is of all the moſt *Grave* [56].

[55]

[56]

Figure

Figure the Sixth.



That it ought to be ſo, is inferred from hence; that wee can begin Diviſions from onely two places of the whole Eighth: ſo that therein either two Tones may be ſet in the firſt place, and, after one Semitone, three Tones conſequent in the laſt place; or, on the contrary, three Tones in the firſt place, and only two in the laſt. And the Term *F* repreſenteth both thoſe two places to-

 gether

gether. For, if from thence we go by *b*, only two Tones, are in the first place: but if by ♮, there will bee three: Therefore.

First, then it is manifest from this Figure, & the second precedent, that onely Five Spaces are contained in a whole Eighth, by which the voyce can naturally proceed, *i.e.* without any Fraction, or moveable Terme, which was to bee found out by Art, that it might proceed further. Whence it came, that those five intervalls should be attributed to a Naturall Voyce, and six only Voyces were found out to expresse them; *viz. ut, re, mi, fa, sol, la.*

Secondly, that from *ut* to *re*, is alwayes a Tone *minor*; from *re* to *mi*, alwayes a Tone *major*; from *mi* to *fa*, alwayes a Semitone *majus*; from *fa* to *sol*, alwayes a Tone *major*; and lastly from *sol* to *la*, a Tone *minor*.

Thirdly, that there can be only two Kinds of an Artificiall Voyce, *viz.* *b* and ♮: because the space betwixt *A* and *C*, which is not divided in the Naturall voyce, can only bee divided by two Modes; so as that a Semitone be set in the first place, or the second.

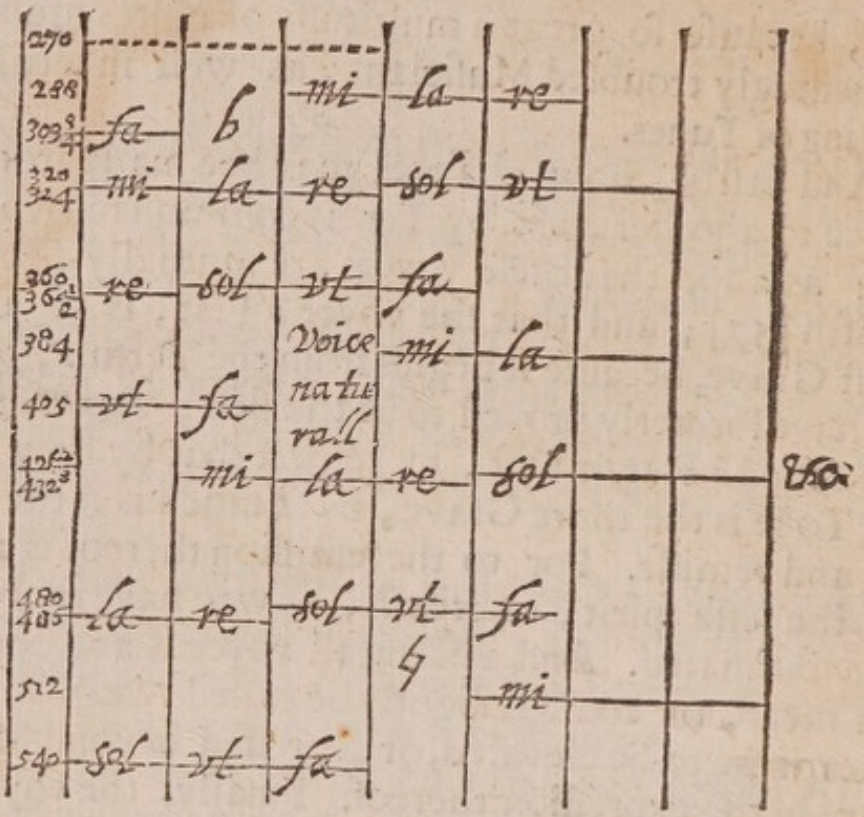
Fourthly, for what reason these Notes, *ut, re, mi, fa, sol, la*, are againe repeated in those Artificiall Voyces: for Example, for, when wee ascend from *A* to *b*, insomuch as there are not other Notes, but *mi* and *fa*, to signifie a Semitone *majus*; it thence follows, that in *A*, *mi* is to be set; and in *b*, *fa*; and so in other places in order. Nor can you say, it had been more convenient to have invented other Notes; for they would have been superfluous, since they must have designed the same intervalls, which are designed by those Notes in a Naturall voyce; besides they would have been incommodi-

ous,

ous, becauſe ſo great a multitude of Notes muſt have exceedingly troubled Muſicians, as well in ſetting, as ſinging of Tunes.

And laſtly, how changes may bee made from one voyce to another, *viz.* by Terms common to two voyces: as alſo, that theſe voyces are mutually diſtant by a Fifth [57]; and that the voyce *b* Flat, is of all the moſt Grave, becauſe it begins from the Term *F*, which we have formerly proved to be the firſt; and therefore it is called *b* Flat or Soft, in reſpect that by how much any Tone is the more Grave, by ſo much is it the more ſoft and remiſſe. For to the emiſſion thereof is required the leſſe ſpirit, or breath, as wee have more then once intimated. And a Naturall voyce is and ought to be a mean, nor could it rightly be called *Naturall*, if the voyce were to be elevated, or depreſſed beyond Mediocrity, in the expreſſion thereof. Finally, the voyce ♮, is called a Quadrate, or Sharp, becauſe it is the moſt Acute, and the oppoſite to *b* Soft or Flat; as alſo, becauſe it divides an Eighth into a Tritone and a Fifth falſe [58], and is therefore leſſe ſweet than *b* Soft. [57] [58]

Some perhaps will object, that this *Hand* is not ſufficient to comprehend all the Changes of Degrees; for, as in it is ſhown, how freely we may deflect from a Naturall voyce, either to *b* Soft, or to ♮; ſo alſo ought other collaterall Orders to bee deſigned therein, ſuch as are ſet in the Sequent Figure; that ſo it might have beene free for us alſo to deflect from *b* Soft, to the Naturall voyce, or to the other part; and ſo from ♮. Which is confirmed from hence, that Muſicians in Practice frequently uſe ſuch intervals, which they explicate either by Dieſis, or by *b* Soft, which they therefore remove from its proper Seat.



To this we return, that by this means might be made a progresse, *usq; ad infinitum* : but, in that *Hand*, ought to bee expressed the Changes of only one Tune ; and that those are contained within three Orders, is demonstrated from hence, that in every Order only six Terms are contained , of which two are changed , when a change is made to the following Order, and so there remain therein only Four Termes of those, which were in the former ; but if a Transition bee againe made to a Third Order , then will two Degrees of the four precedent ones bee changed, and so there will remain onely two of those which were in the former Order , which would lastly be taken away in the fourth Order , if the progresse should be continued unto it, as is visible in the Figure:

Figure: whence it is most evident that the Tune would not be the same it was in the beginning, since therein would remaine no Term unchanged. And what is added concerning the use of *Dieses*; I say, that they doe not constitute whole Orders, as *b* Soft, or ♮, but consist only in one Terme, which they elevate (as I conceive) by one Semitone *minus*, all the other Terms of the Tune remaining unchanged; now the manner how, and the reason why this is done, I doe not at present so well remember, as to be able sufficiently to explain; nor why, when only one Note is elevated above *la*, a *b* Soft is usually affixed unto it: which I think may easily be deduced from Practice, if the Numbers of those Degrees, in which they are used, and of voyces, which with them make Consonances, bee subducted; and the matter I judge well worthy a serious Meditation.

Finally, here it may be objected, that six voyces, *ut*, *re*, *mi*, *fa*, *sol*, *la*, are superfluous, and only Four may suffice; since there are only three divers intervalls: by which way that any Musicall Tune can be sung, I deny not. But because there is great difference betwixt the Terms Grave and Acute; and a Grave Term, as is formerly noted, is much the chiefest: therefore is it better and more commodious to use divers Notes, than the same towards an Acute part, and towards a Grave part.

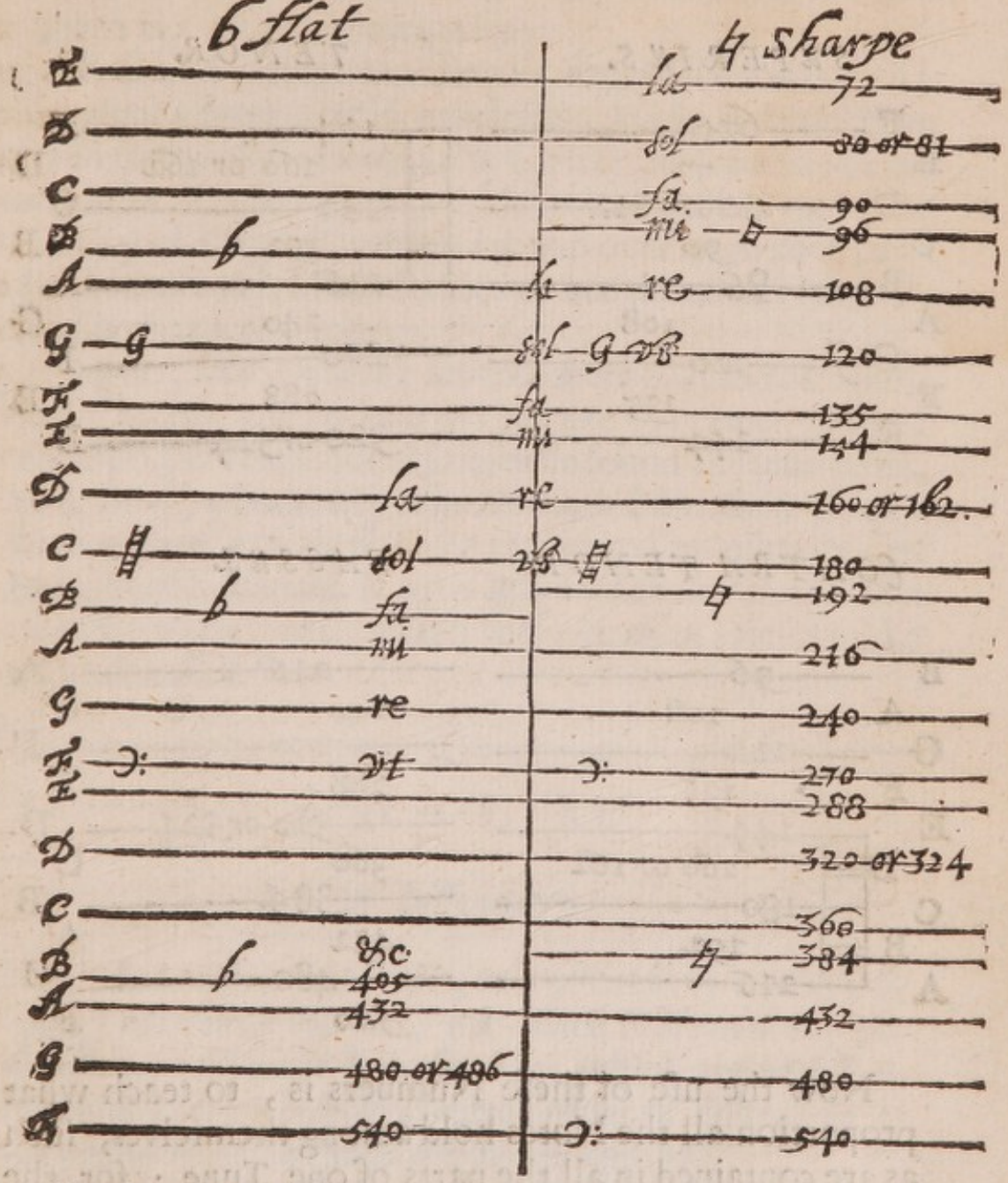
This place requires us to explain the *Practice* of these Degrees, how Musicall parts are constituted of them, and by what reason ordinary Musick composed by practicall hands may be accommodated to what of the Theory hath been premised; that so all Consonances and other its intervalls may bee exactly calculated. In order

order to our effecting of this, wee are to know, that Practitioners describe Musick betweene five lines, to which others also are added, if the Tones of the Tune bee further extended; and that these Lines are distant each from other, two Degrees, and therefore that betwixt two of them, one other is alwayes to bee understood, which is omitted for brevity & commodity sake. Again, since all the Lines are equally distant each from other, but signifie unequall spaces: therefore are Two Markes invented, *b* and ♮, one whereof is set in that chord, which represents the Term *B fa*, ♮ *mi*. Further, because one Tune doth frequently consist of many parts, which parts are seperately described; it is not yet known, from those Marks, *b* and ♮, which of these many parts is superior, and which inferior: and therefore are there three other Marks found out.):, |≡|, *G*, the order whereof we have formerly observed [59]. Now that all these things may be the more manifest, wee have here placed this following Figure, in which wee have expressed all the Chords, and removed them each from other more or lesse, according to the greater or lesser spaces which they denote [60]; that so the proportion of Consonances might be presented together to the eye. Besides, wee have made this Figure double, that the Difference betwixt *b* and ♮, might be visible; nor can those Tunes, which are to be sung by one, be described by the other, unlesse all the Tones of these be removed by a Fourth or Fifth, from their proper Seat, so that where stands the Term *F ut fa*, there is to be set *C sol ut fa*.

[59]

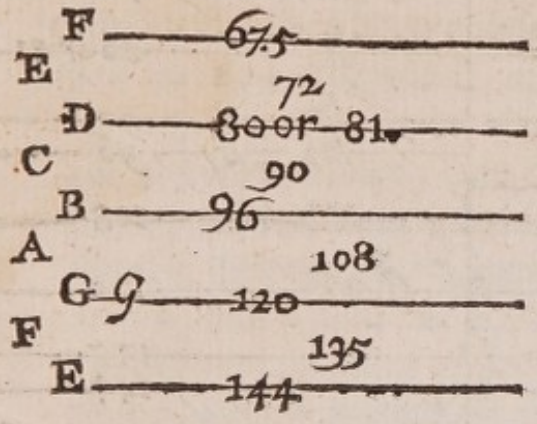
[60]

Further

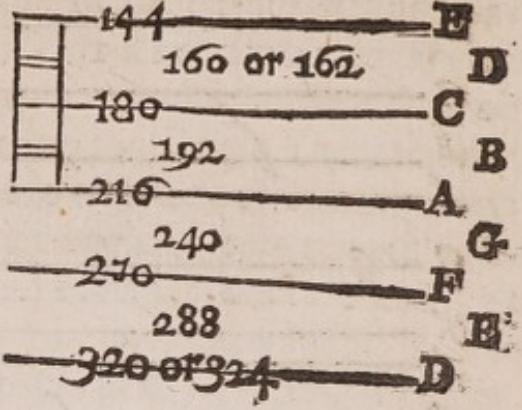


Further than this we are not to goe, for these ought to be the Terms, since they divide three Eights, within which all Consonances are included, to which the Practice of Musicians doth accord, for they hardly ever exceed this space.

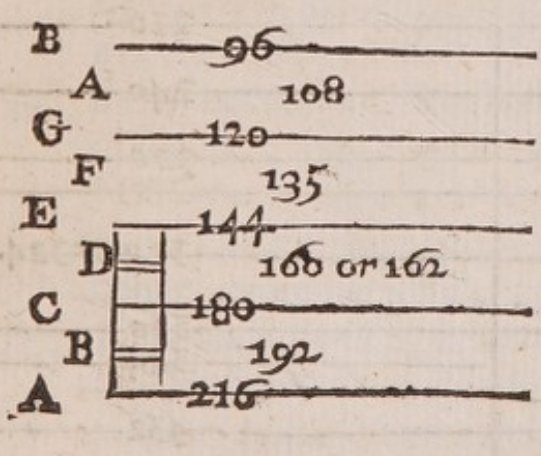
SUPERIUS.



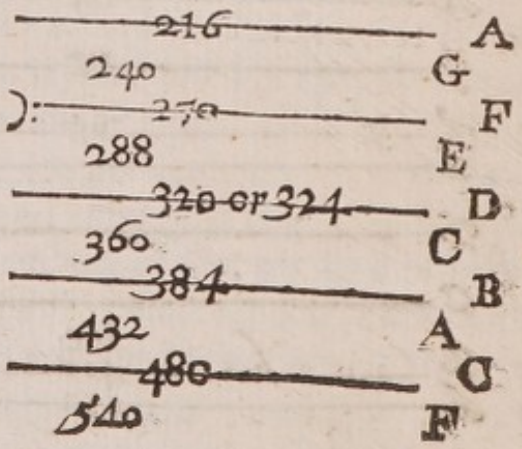
TENOR.



CONTRA TENOR.



BASSUS.



Now the uſe of theſe Numbers is, to teach what proportion all the Notes hold among themſelves, ſuch as are contained in all the parts of one Tune: for the ſounds of theſe Notes hold the ſame proportion one to another, as the numbers appoſed on the ſame Chords. So as if the ſtring be divided into 540 equall parts, and the ſound thereof repreſent the moſt Grave Term *F*:

480

480 parts of the same string will yield the sound of the Term G; and so consequently.

And here we have ordered 4 degrees of Parts, that it might appear, how much they ought to bee distant each from other; not that the Cliffs):, |≡|, and *G* are not often set in other places, which is done according to the variety of Degrees, which are run over from each part: but because this Mode seemes to bee the most Naturall, and is the most frequent.

Again, here have we set Numbers only in the Naturall Chords, and so long as they are not removed from their proper seat; but if Dieses be found in some notes, or ♭, or ♮, which may remove them from their proper seats: then are those to be explicated by other Numbers, whose quantity is to be desumed from other Notes of other Parts, with which these kinds of Dieses make a Consonance.

CHAP. XI.

Of Dissonances.

ALL other Intervalls, except those of which wee have now spoken, are called Dissonances; but we will treat of those only, which are necessarily found in the newly explicated order of Tones, so as they cannot but be made use of and applyed.

Of these there are three kinds[61]: (1) Some are generated from Degrees only, and an Eighth: (2) Others from the difference which is betwixt a Tone *major* and *minor*, which we have denominated a Schism: and [61]

(3)others from the Difference, which is between a Tone
[62] *major*, and a Semitone *majus* [62].

In the *First Genus*, are contained Sevenths and Ninths, or Sixteenths, which are only Ninths compounded, as Ninths are nothing else but Degrees compounded of an Eighth, and Sevenths nothing but the residue of an Eighth, from which one Degree is detracted; whence it is manifest, that there are three divers Ninths, and three Sevenths, because there are three kinds of Degrees; and all these consist betwixt these Numbers
[63] [63]:

A	*Ninth maxim*	$\frac{4}{9}$	A	*Seventh major*	$\frac{8}{15}$
	Ninth major	$\frac{9}{20}$		*Seventh minor*	$\frac{3}{5}$
	Ninth minor	$\frac{15}{32}$		*Seventh minim*	$\frac{9}{16}$

Among Ninths, two are *majors*, which arise from two Tones, the First from a *major*, the Second from a *minor*, for the distinction of which we have noted one Ninth maxim: on the contrary there are two Sevenths *minors*, for the same reason, and therefore we have called one Seventh minim.

Now, that these Dissonances cannot be avoyded in sounds successively emitted, among divers parts is most clear: yet haply any one may enquire, why they ought not to be admitted in a voyce successive of the same part equally with Degrees, since it is evident that some of them are explicated in lesser Numbers than the Degrees themselves, and therefore may seem to bee more
[64] gratefull to the Hearing than Degrees [64]. The solution of which Doubt doth depend on this, which we have
[65] before observed, that a voyce [65] doth require so much

the

the more intenſion of the ſpirit or breath, by how much the more Acute it is, and therefore Degrees were invented, that they might be *Meanes*, betwixt the Termes of Conſonances, and that by them wee might the more eaſily aſcend from the Grave Terme of any Conſonance to the Acute of the ſame, or *vice verſa*, deſcend from the Acute to the Grave Term: which cannot be performed by Sevenths or Ninths, as is evident from hence, that the Termes of theſe are more diſtant each from other, than the Termes of Conſonances are, and therefore they would be emitted with a greater inequality of Contention.

In the *Second Genus* of Diſſonances do conſiſt a Third *minor*, and a Fifth Deficient by one Schiſme; as alſo a Fourth, and a Sixth *major* encreaſed by one Schiſme. For ſince (neceſſarily) there is one moveable Terme by the intervall of a Schiſme, in the whole Series of Degrees; it cannot be avoyded, but that, from thence, ſuch Diſſonances in relation, *i.e. in voce ſucceſſivè emiſſa a diverſis vocibus*, will bee generated: And that more then theſe now named cannot ariſe from thence, may bee proved by induction [66]. Theſe conſiſt in theſe Numbers [67]: [66] [67]

A {
- *Third minor defective* —— $\frac{27}{32}$
- *Fifth defective by one Schiſm* —— $\frac{27}{40}$
- *Fourth increaſed by one Schiſm* —— $\frac{20}{27}$
- *Sixth major increaſed by a Schiſm* —— $\frac{48}{81} \mid \frac{16}{27}$

}

[68] Or thus [68],

A	*Third minor defective by a Schism*	G *ad* b.	480,	405.
		♮ *ad* D.	384,	324.
	Fifth defective by one Schism	G *ad* D.	480,	324.
	Fourth encreased by one Schism	D *ad* G.	324,	240.
	Sixth major encreased by a Schism	b *ad* G.	405,	240.
		D *ad* ♮.	324,	192.

But so great are these Numbers, that such intervalls cannot be tollerated of themselves; but, as we have formerly noted, because the intervall of a Schisme is so small, as it can hardly bee discerned by the ears, therefore doe they borrow sweetnesse of those Consonances, to which they are neareſt. Nor doe the Terms of Consonances so consist *in indivisibili*, as that if one of them be a little changed, all the sweetnesse of the Consonance must instantly be lost: and this can only be the reason, why Dissonances of this *Second Genus* may be, in a voice successive of the same part, admitted in place of Consonances, from which they are divided.

In the *Third Genus* are contained, a Tritone, and a Fifth false; for in this, a Semitone *majus* is accounted for a Tone *major*; but in a Tritone, the Contrary: and they
[69] are explicated by these numbers [69]:

Tritone $\frac{32}{45}$ *Fifth false* $\frac{45}{64}$

Or

Or thus [70]: [70]

A { *Tritone* { F *ad* ♮ . 540, 384. / b *ad* E. 405, 288. } / *Fifth false* { ♮ *ad* F. 384, 270. / E *ad* b. 288, 202½ *vel* 576, 405. } }

Which Numbers are alſo too great to explicate any intervall which may not be ingrate to the ears; nor have they any Conſonances very near, from which they may borrow ſweetneſſe, as the Præcedent ones have. Hence comes it, that theſe laſt Diſſonances ought to be avoided in relation; at leaſt, when ſlow and ſoft Muſick is made, and not diminute; for in very diminute Muſick and ſuch as is ſung ſwiftly, the hearing is too much imployed to take notice of the defects of ſuch Diſſonances: which defect is much more evident from hence, that they are near to a Fifth, with which the Hearing therefore compares them, and, from the precipuous ſweetneſſe of this, doth the more clearly diſcern the imperfection of thoſe.

Here we ſhall end our explication of all the Affections of a Sound; having firſt only taken notice, in order to the probation of what we formerly ſaid, that all the Variety of ſounds, as to Grave and Acute, doth ariſe in Muſick onely from theſe Numbers 2, 3, and 5. we ſay that all numbers, by which aſwell Degrees, as Diſſonances are explicated, are compoſed of thoſe three, and by them, diviſion being made, may at length bee reſolved even to an unity.

CHAP.

CHAP. XII.

Of the reason of composing.

FRom the Premises it followes, that we may, without any great errour or solœcism, compose Musick, if we observe these 3 axioms.

1. That all sounds which are emitted together, may be distant each from other, in any Consonance, except a Fourth, which lowest ought not to be heard, *i.e.* against a Basse.

2. That the same voice be moved successively, only by Degrees, or Consonances.

3. Lastly, That we admit not a Tritone, or Fifth false, no not so much as in relation.

But, for the greater Elegancy and Concinnity, we are to note these following Rules.

1. That wee begin from some one of the most perfect Consonances; for, so is raised a greater attention, than if some jejune and frigid Consonance led up the Van: or else, most gratefully, from a pause or silence of one voyce; for when, immediately upon the silence of one voyce, which began the Tune, another unexpected one First invades the ears, the novelty thereof doth by a kind of potent charm, conjure us to attention. Now, concerning a Pause we have been hitherto silent, because of it self a Pause is nothing, but onely induceth a certain novity and variety, while the voyce, which was silent, doth againe begin to sing.

2. That two Eights, or two Fifths never immediately

ately succeed each other. The reason why that is prohibited more expresly in these Consonances than in others, is because these are the most perfect, and therefore when one of them is heard, then is the Hearing therewith fully satisfied, and unlesse the attention bee presently removed from that to another Consonance, it is wholly occupied by the pleasantnesse thereof, so that it can little regard the variety, and the (in some sort) frigid Symphony of the Tune; which happens not in Thirds and other Consonances, no though they be reiterated, for in all others the attention is still kept up, and a desire encreased of expecting a more perfect Consonance.

3. That so much as possible, the parts goe on in contrary motions, in order to the greater variety: for then both the motion of every voice is distinguished from the adverse voice, and Consonances are distinguished from other Consonances near them. Also that all the voyces be moved oftner by Degrees, than by leaps.

4 That, when we would advance from any lesse perfect to a more perfect Consonance, wee alwayes deflect to one that is near, rather than to one that is remote; for example, from a Sixth *major* to an Eighth, from a Sixth *minor* to a Fifth, *&c.* understanding the same also of an Unison and the most perfect Consonances. Now, the reason why this method is to bee observed in progression from imperfect to perfect Consonances, rather than *e contra*, from perfect to imperfect; is, because, when we heare an imperfect Consonance, the eares are induced to expect a more perfect one, wherein they may receive more satisfaction, and to this expectation are they carryed by a certain naturall violence: and there-

fore ought a more vicine, than a remote Consonance rather to be set, that being what the Hearing desires. But, on the contrary, when a perfect Consonance is heard, we expect no imperfect one. Yet this Rule is subject to frequent variation, nor can we now call to mind, from what to what Consonances in particular, and by what motions wee ought to pervene: all these depend on experience, and the practice of Musicians; which being known, we conceive it no difficulty to deduce the reasons and proportions of all from this our Theory of Musick: and I have formerly deduced many of them, but my peregrinations have worn them out of both my Papers and Memory.

5. That, in the end or close of each Tune, the eares be so fully satisfied, as they expect no more, but perceive the Tune to be perfect: which is most conveniently effected by some Orders of Tones alwayes ending in a most perfect Consonance, which Orders Musicians call Cadences, all the Species of which Cadences have been copiously enumerated by *Zarlinus*. Who hath Generall Tables or Schems also, wherein are described what Consonances in particular ought to succeed each other through a whole Tune; of all which hee hath given some reasons, but we believe that more and more plausible ones, may be deduced from our Fundaments.

6. And lastly, that the whole Tune together, and every voyce seperately be included within certain limits, which are called Modes, of which anon.

All these Rules are to bee exactly observed in the Counter-poynt of only two, or more voices; but not in a Diminute, nor any way varied: for in Tunes very Diminute, and (as they call them) Figurate, many of them

them are remitted. Which that we briefly explicate, wee are concerned first to treat of the foure Parts, or Voices used in Tunes; for though in some are found more, in some fewer Symphonies: yet that seems to bee the most perfect and most usuall Symphony, which is composed of four Voices.

The First and most Grave of all these Voices, is that which Musicians call *Bassus*. This is the chiefe, and ought principally to fill the ears, because all other Voices carry the chiefest respect to the *Basse*, the reason whereof we have formerly declared. Now, this Voice is wont to move on not onely by Degrees, but also *per Saltus*; the reason is, because they were invented to ease that trouble, which would arise from the inequality of the Terms of one Consonance, if one should immediatly bee expressed upon the neck of another; since the more Acute doth strike the eare much more forcibly than the Grave. For this trouble is lesse in a *Basse*, than in other parts; in respect that it is the most Grave, and therefore requires lesse strength of the spirit or breath to its effusion, than any other. Besides, since all other Voices hold a respect to the *Basse*, as the principall; it ought to strike the ears more sensibly, that it may bee heard more distinctly: which is effected, when it moves on *per Saltus*, *i. e.* by the Terms of lesser Consonances immediately, rather than when it moves on by Degrees.

The Second, being the next to the *Basse*, they call *Tenor*; this being also, in its kind, the chiefest, because it containes the Subject of the whole Modulation, and is comparatively the Nerve, which extended through the body of the Tune, doth sustain and conjoyn all the rest of its Members. And therefore it is wont, so much as

possible, to move on by Degrees; that so its parts may be the more united, and the Notes of it may be the more easily distinguished from the Notes of other Voices.

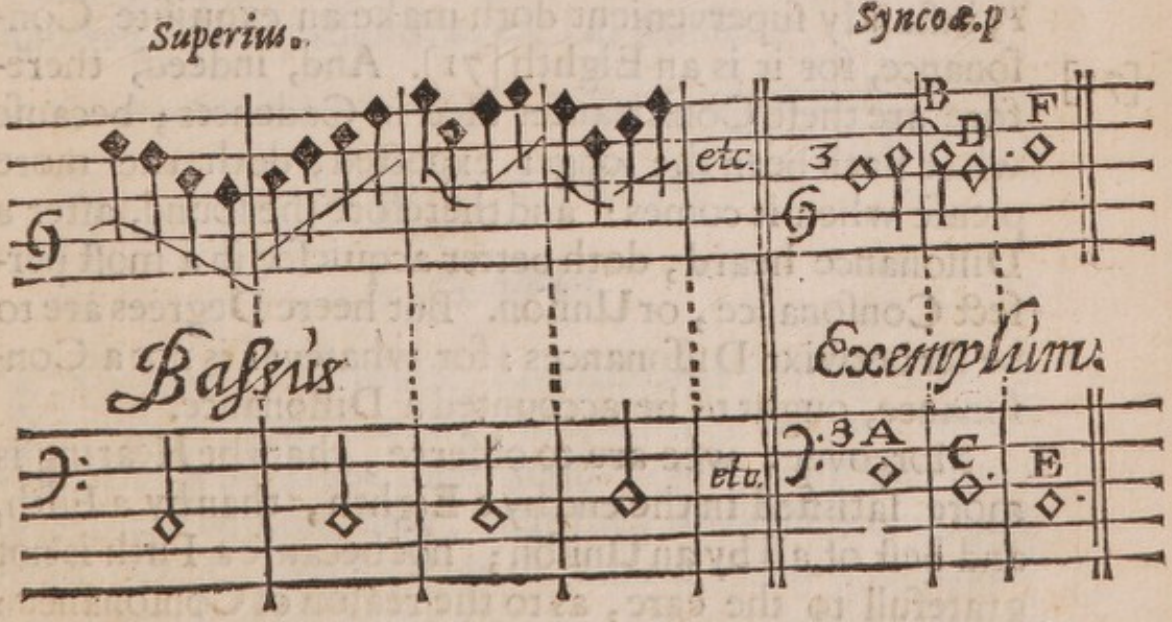
To the *Tenor* is opposed the *Contra-tenor*; nor is it used in Musick for any other reason but because, by progressing to contrary motions it may occasion Variety, and so Delight. It is wont, as the *Basse*, to move on by leaps; but not for the same reasons: for this is done only for convenience and variety; for it consists betweene two voices, which move on by Degrees. Practisers so compose their Tunes sometimes, that they descend below a Tenor; but this is of small moment, nor doth it seem at any time to adfer any novity, unlesse in imitation, consequence, and the like artificiall counter-poynts.

Superius is the most Acute voice, and is opposed to *Bassus*, so that by contrary motions they frequently occur each to other. This voice ought chiefly to incede by Degrees; because, since it is most Acute, the difference of Terms in this would cause greater trouble and difficulty, if those Terms, which it would successively emit, were at too great distance each from other. And it is wont to be moved the swiftest of all others in Diminute Musick: as the *Counter-Basse* most slowly: the reasons whereof are deduceable from our precedent discourse; for a more remisse sound strikes the Ears more slowly, and therefore the Hearing cannot endure so swift a mutation therein, in respect it would not have leasure to hear all the single Tones distinctly.

These things thus explained, we are not to omit, that in these Tunes Dissonances are frequently used instead of Consonances; which is effected two wayes, *viz.* by Diminution

Diminution, or Syncope.

1. *Diminution* is when against one Note of one part, are set 2. or 4. or more in another; in which this order ought to be kept, that the First make a Consonance with a Note of another part, but the Second, if it be only one Degree distant from the former, may make a Dissonance, and also be, by a Tritone, or Fifth fals, distant from another part, because then it seems there set only by accident: and as a way, by which wee may come from a First Note to a Third, with which that First Note ought to make a Consonance, as also doth the Note of the opposite part. But, if that Second Note incede *per Saltus*, *i. e.* bee distant by the intervall of one Consonance from the First; then ought it to make a Consonance also with the opposite part: for the former reason ceaseth. But then a Third Note may make a Dissonance if it be moved by Degrees; of which let this be an Example.



A *Syncopa* is, when the end of one Note in one voice is heard at the same time with the beginning of one other Note of an adverſs part; as may bee ſeene in the Example ſet, where the laſt time of the Note *B*, is diſſonant with the beginning of the Note *C*, which is therefore brought in, becauſe there is yet remaining in the eares the recordation of the Note *A*, with which it made a Conſonance; and ſo *B* bears it ſelfe to *C*, only as a Relative voyce, in which the Diſſonances are carryed through: yea, the Variety of theſe doth cauſe, that the Conſonances, among which they are ſet, are heard more diſtinctly, and alſo excite the more conſtant attention. For, when the Diſſonance *B C* is heard, the expectation of the eare is encreaſed, and the judgement of the ſweetneſſe of the Symphony ſomewhat ſuſpended, untill the Tune ſhall arrive at the Note *D*, in which it more ſatisfies the Hearing; and yet more perfectly in the Note *E*, with which, after the end of the Note *D*, hath kept up the attention, the Note *F*, inſtantly ſupervenient doth make an exquiſite Conſonance, for it is an Eighth [71]. And, indeed, therefore are theſe Conſonances uſed in Cadences; becauſe what hath been the longer expected, doth the more pleaſe when it comes: and therefore the ſound, after a Diſſonance heard, doth better acquieſce in a moſt perfect Conſonance, or Uniſon. But heere Degrees are to be ſet betwixt Diſſonances: for whatever is not a Conſonance, ought to be accounted a Diſſonance.

[71]

Moreover, wee are to obſerve, that the Hearing is more ſatisfied in the end by a Eighth, than by a Fifth, and beſt of all by an Uniſon; not becauſe a Fifth is not gratefull to the eare, as to the reaſon of Conſonance: but

but because in the end we are to regard Quiet, which is found greater in those sounds, betwixt which is lesse difference, or none at all, as in a Unison. Now this Quiet, or Cadence is delectable not only in the end: but also in the midle the avoidance of this Cadence introduceth no small delight; namely, when one part seems willing to quiesce, and another proceeds on. And this is a kinde of Figure in Musick, such as are Rhetoricall *Figures* in Oration, of which sort are *Consequence*, *Imitation*, *&c.* which are effected, when either two parts successively, *i. e.* at divers times, sing wholly the same, or a quite Contrary, which at last they are wont to doe. And truely this, in certain parts of a Tune, doth sometimes much advantage Musick; but as for those artificiall *Counter-poynts*, as they call them; in such Composures where that Artifice is observed perpetually from the beginning to the end: we conceive, they may belong not more to Musick, than *Acrosticks*, or retrograde Verses to *Poesie*, which was invented to charm the mind into respective passions, as well as Musick.

CHAP. XIII.

Of Modes.

FRequent it is among Practitioners to treat of these Modes, and what they are, all well know; therefore would it be superfluous here to insist thereon: wee shall observe only, that they have their originall from hence, that an Eighth is not divided into equall Degrees, for one while a Tone, another while a Semi-

tone

tone is found therein: and beſides, from a Fifth, becauſe that of all others is moſt acceptable to the eare, and every Tune ſeemes to bee compoſed for the ſake of this alone: for an Eighth can be divided into Degrees,
[72] onely ſeven different wayes [72], every one of which
[73] may bee againe divided by a Fifth two wayes [73], ex-
[74] cept Two [74]; in one of which is found a Fifth falſe
[75] in place of a Fifth [75], whence there ariſeth onely twelve Modes, of which foure are leſſe elegant, for this
[76] cauſe, that a Tritone is found in their Fifths [76], ſo as they cannot, from a Fifth principall, and for whoſe ſake the whole Tune ſeems compoſed, aſcend or deſcend by Degrees, but of neceſſity there muſt occur a falſe Relation of a Tritone, or a Fifth falſe.

In every Mode, are three principall Termes, from which all Tunes ought to bee begun, and moſt chiefly
[77] concluded [77], as all Muſicians know: and they are called Modes as well from hence, that they reſtrain the Tune, leaſt the parts of it ramble beyond mediocrity to exceſſe; as from hence chiefly, becauſe they are apt to containe various Tunes, which may diverſly affect the minde according to the variety of Modes; of which many things have been ſayd by Practiſers, taught onely by experience, the reaſons of all which may be deduced from our precedent diſcourſe: for, certaine it is, that in ſome many Ditones, or Thirds *minors*, and in places more or leſſe principall, are found, from which almoſt all the variety of Muſick doth ariſe, as hath beene formerly proved. Again, as much may be ſayd of Degrees themſelves; for a Tone *major* is the Firſt, and comes neareſt to Conſonances, and is *per ſe* generated from the
[78] Diviſion of a Ditone; but all others *per Accidens* [78],

from

from which and the like, many things concerning the nature of Moods might bee deduced, if a *Compendium* would permit. And heere it should follow, that wee should discourse of all the motions of the minde, which may bee excited by Musick, and in a singular Treatise shew, by what Degrees, Consonances, Times, *&c.* those motions ought to bee excited: but I should bee unconstant to my purpose of writing an Epitome.

I now discover Land, hasten a shoare, and omit many things for brevity, many by oblivion, but more by ignorance. However, I suffer this issue of my braine, so inform, and lately brought forth rude as a Bears Cub, to venture abroad into your presence: that it may remain as a Monument of our Familiarity, and a most certain memoriall of my love of you: yet, if you please, upon this condition, that, being confined to the secresie of your Closet, it bee not exposed to the Judicature of others, who may not (as I trust you will) avert their benevolous eyes from the maimed, and defective parts of this Exercise, upon those others, in which I deny not but I have expressed some Lineaments of my Ingenie to the life; nor would they know that this *Compendium* was composed for your sake alone, by one who could not obtain Privacy in an Army, nor leasure in a Throng of other Cares and Affairs.

CONTENTS.

CHAP.

FINIS.

ANIMADVERSIONS
UPON THE
Musick-Compendium
OF
RENAT. DES-CARTES.

LONDON,

Printed by *Thomas Harper*, for *Humphrey Moseley*, and are to be sold at his Shop at the Sign of the *Princes Armes* in S. *Pauls* Church-Yard. 1653.

ANIMADVERSIONS

UPON THE

Mathematicall Compendium

OF

RENAT. DES-CARTES.

Animadversions upon the *Musick-Compendium* of *R. Des-Cartes.*

In these Subsequent *Animadversions*, *brevitatis gratia*,

I Characterize thus:

Roote, or Side	√
Addition, or more	+
Subduction, or lesse	−
Æqualitie	=
Aggregate, or Sum	Z
Excesse, or Difference	X.
Lower, or Graver	▽
Lower, or Graver Term	▽̄
Higher, or Acuter	△
Higher, or Acuter Term	△̄
Ration	Rx
Æquality of Ration, or proportionall	: :
Continued Proportion	∴
Multiplyer, or multiplyed by	mr
Divisor, or divided by	⌐
Product	⌐
Quotient	⌐
Potestas	⌐
Logarithme	⌐

And, *distinctionis causa*, I denominate the first Note or Term of any Consonance, or other Musicall Intervall, an *Unison*; and the other, according to its difference, in sound, from the former.

[1] *Audible Differences are as visible Rations*: For Sounds cannot bee distinguished, or their Differences known otherwise than by their mutuall habitude. understand me as thus: The *Sounds* of strings are according to their *Rations*, not visible *Differences*: for Example, as these three *Chords* have an *equality* of *Rations*: (for *a.b* :: *b.c.*) so their *Sounds* (an *Unison*, *Eighth*, and *Fifteenth*) have an *equality* of *Differences*. (For $1 \overset{*}{+} 7 = 8$, and $8 \overset{*}{+} 7 = 15$.) And as these three *Chords* have an *inequality* of *Rations*: (though an equality of Differences visible; for $d \overset{*}{+} g = e$, and $e \overset{*}{+} g = f$.) so their *Sounds* (an *Unison*, *Fifth*, and *Eighth*) have an *inequality* of *Differences audible*. For as the Ration of *d* to *e*, is $\frac{2}{3}$: (and $\frac{2}{3}$ is a Fifth, by Fig. first, p.10.) so the difference of an Unison and a Fifth is a Fifth. ($1 \overset{*}{+} 4 = 5$.) and as Rt of *e* to *f* is $\frac{3}{4}$: (and $\frac{3}{4}$ is a Fourth by Fig. first, p. 10.) so the difference of a Fifth and an Eighth is a Fourth. ($5 \overset{*}{+} 3 = 8$.) And (therefore) Sounds, thus numbred, are as it were imperfect (because not equally distant) audible Indices, or Logarithms of their Chords. Here the Reader may observe that for the Difference of an *Eighth*, I have added

ded only *seven*; of a *Fifth*, *four*; and of a *Fourth*, *three*: and the reason is, because the exclusive account is alwayes one lesse than the inclusive, as is made visible *Animad.* 8.

[2] *Viz. Arithmeticall.* Whereof on strings are two sorts; one *audible*, the other *visible*; but, as to their measure, the *Last* only is properly called *Arithmeticall*; the *first Rationall*, or *Geometricall*.

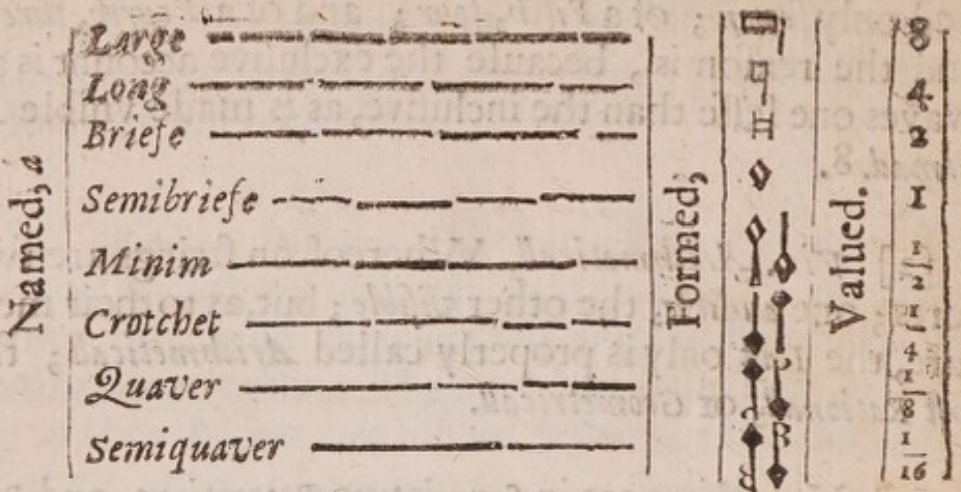
[3] Note there are in *Sounds* two *Proportions*, and *Progressions*, as well as in Lines and Numbers; *viz.* the *Arithmeticall*, as Second, Third, and Fourth: for $2-1=3-2=1$: and the *Geometricall*, as Second, Third, and Fifth: for 1. 2 :: 2. 4. And note also, as was sayd before Animad. First: That when *Strings* are *audibly* in an *Arithmeticall* proportion, or progression, they then are *visibly* in a *Geometricall*; whence I infer that Chords, as to *Sounds*, ought to be Geometrically divided, not Arithmetically; because, so divided, the sence of hearing has not so much to advertise; the audible Differences being alwayes equall, *&c.* whereof more, after Anim. 78, P. 1.

[4] $\sqrt{8}=2{\cdot}828+$, therefore is $\begin{cases} ab=0{\cdot}828+ \\ bc=1{\cdot}172- \end{cases}$

[5] *Viz.* 0·8.

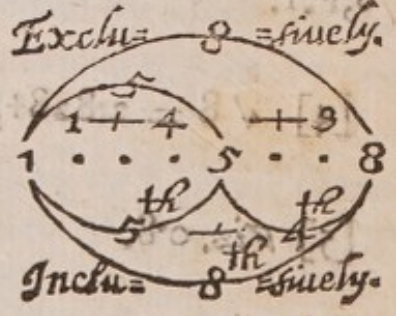
[6] *Viz.* 1·2.

[7] The Notes, or Markes of *Time*, in Musick are thus Named,



But note theſe Markes are found otherwiſe valued ſometimes; as when a Large doth comprehend three Longs, a Long three Briefes, *&c.* according to their ſeverall Moods; or Moods, Times, and Prolations: For ſatisfaction wherein, as in all things elſe practicall in Muſick, not neceſſary to be known, as to the underſtanding of this *Compendium*, the Reader is referred to *Harmonicon Merſenni*, *Muſurgia Kercheri*, *Morleys* Introduction, *&c.*

[8] That is, is *Four* or *Seven Notes* higher: For the *Fifth* is the *Fourth* from the Firſt, and the *Eight* is the *Seventh*, *&c.* The knowledge of which Notes, together with all other *Conſonances*, and *Muſicall Intervalls* (ſome few excepted, not now in uſe,) may bee, without difficulty, obtained by inſpection on the firſt Figure following.



Whereof

Whereof the *Space* from the *Bridge* to the *Natt*, is understood to be divided into 540, or 10·000 equall parts: the Number of which parts (accounting from the Bridge) to each actuall division of the foure Chords, or Strings, numbred at the Bridge 1, 2, 3, 4; is to be found on the Right hand. The first (B 0) presents you all the Intervalls under an *Eighth*; and their proportions, names, and differences by paralell entrance thence towards the Right hand. and is thus to be read: *viz.* B 0 [540, or 10·000], is to B 1 [518·4, or 9·600], as 25, to 24: as an *Unison*, to its Acuter *Semitone minus*: B 0 [540, or 10·000]. B 2 [506·25, or 9·375] :: 16.15 :: *Unison.* △ *Sem. major*: B 21 [270, or 5·000]. B 20 [281·25, or 5·208 $\frac{1}{3}$] :: 24.25 :: *Unison.* ▽ *Sem. minor*: B 21 [270, or 5·000]. B 19 [288, or 5·333 $\frac{1}{3}$] :: 15.16 :: *Unison.* ▽ *Semit. major*: The *Habitude*, or Proportion of B 1, to B 2; or of B 2, to B 1: or the difference of a Semitone *minor*, and *major*; or of a Seventh *major*, and Semi-Eighth; is a *Diesis minor*, *&c.* Hence it appeareth that B 0, if struck, when stop'd at 1, doth sound a Semitone *minor* more acute, than it doth, if struck, when unstop'd or open: and that a Semitone *minor* (as 01) is equall to $\frac{1}{25}$ of the $\frac{*}{\nabla}$, and is substracted from it; and $\frac{1}{13}$ of the $\frac{\triangle}{*}$, and is added to it. And the like (*mutatis mutandis*) in all the Rest.

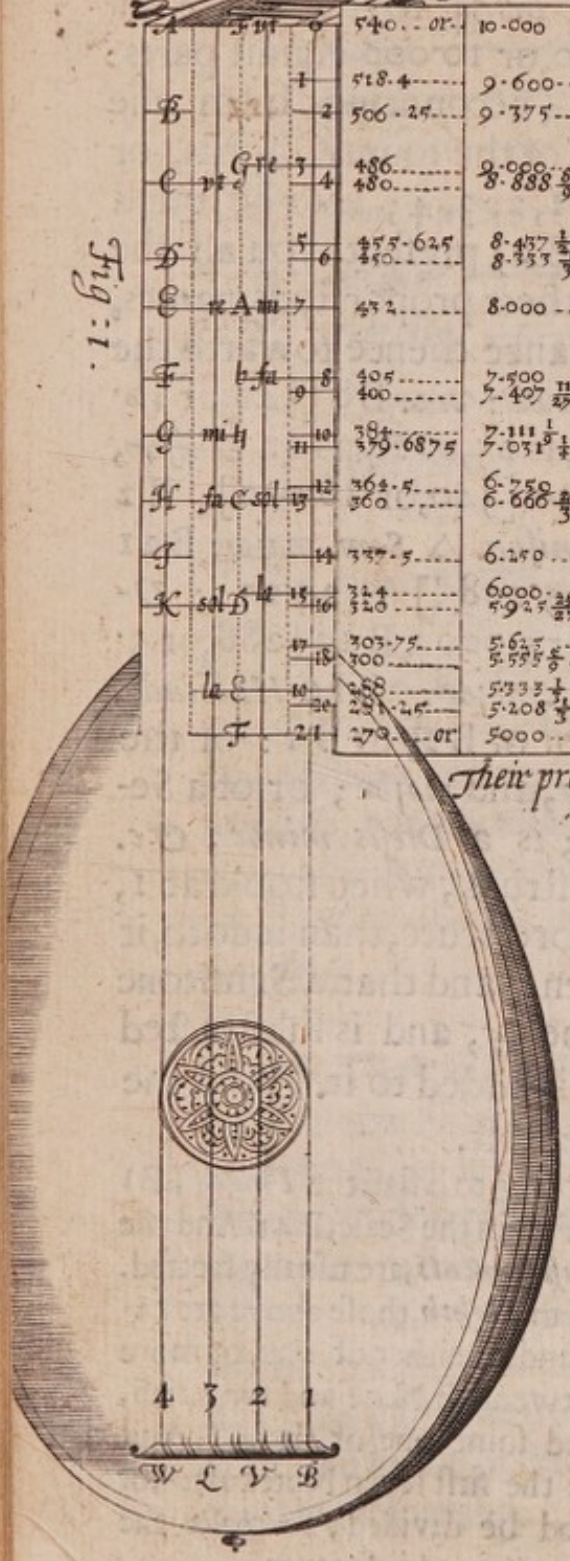
The *Second Chord* (VF) is divided according to b flat: the *Third* (I F) according to ♮ shape: both, from F to F, as in the Scale, P. 41. And the *Fourth* (W A,) as these, and the like *Instruments*, are usually fretted.

Thus having all the *Intervalls* under an *Eighth*, those above are easily known: for they are all compounded either of one, or more Eighths only; as the *Fifteenth*, Two & twentith, Nine and twentith, &c. or else of one, or more Eighths, and some one of these. And (therfore) as B 0 was divided, to make the first seven Notes after, or above the *Unison*, so is B 21 understood be divided, to make the seven next after, or above the *Diapason*, *&c. ad infinitum*.

Animadversions upon the

Their Proportions, Denominations,

Fig. 1.



540 . . or	10.000	is to	as	to	as an Vnison, to its acutex
518.4	9.600		25	24	Semitone minor; or Diesis major
506.25	9.375		16	15	Semitone major; or Degree minor
486	9.000		10	9	Tone or second minor; or degree major
480	8.888 8/9		9	8	Tone or second major; or degree maxim
455.625	8.437 1/2		32	27	Third minor — Schisme
450	8.333 1/3		6	5	Third minor; or Semiditone
432	8.000		5	4	Third major; or Ditone
405	7.500		4	3	Fourth, or Tessaron
400	7.407 11/27		27	20	Fourth + Schisme
384	7.111 1/9		45	32	Triton e
379.6875	7.031 1/4		64	45	Semififth
364.5	6.750		40	27	Fifth — Schisme
360	6.666 2/3		3	2	Fifth; or Diapente
337.5	6.250		8	5	Sixth minor; or diapente + Semit: major
324	6000		5	3	Sixth major; or diapente + Tone minor
320	5.925 25/27		27	16	Diapente + Tone major
303.75	5.625		16	9	Seuenth minim; or Diapason — Tone major
300	5.555 5/9		9	5	Seuenth minor; or Diapason — Tone minor
288	5.333 1/3		15	8	Seuenth major; or Diapason — Semitone maj:
281.26	5.208 1/3		48	25	Semi-eighth
270 . . or	5000	is to	2	1	Eight[th] or Diapason

Their propor:-

Fig. 2.

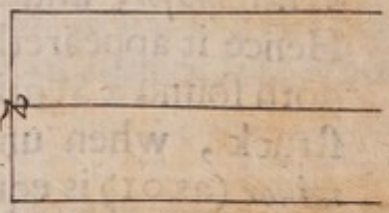


Fig. 3.

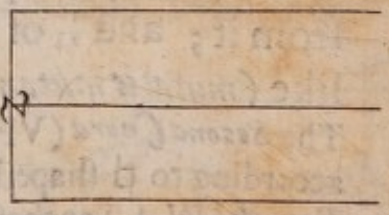
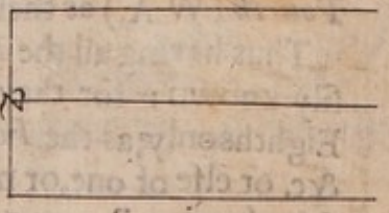


Fig. 4.



Musick-Compendium of R. des-Cartes

		Denominations,	Differences.
1	2	Eighth, or Diapason	
			Semitone minor, or Diesis major, or Chromatica.
25	48	Semi-Eighth	
			Diesis minor, or Enharmonica. as 128. to 125. Δ.
8	15	Seventh major	
			Semitone minor.
5	9	Seventh minor	
			Schisme i.e. as 81 to 80 Δ. as 80 to 81 ∇.
9	16	Seventh minime	
			Semitone, or Limma Pythag. as 243 to 256. ∇.
16	27	Fifth + Second major	
			Schisme, or Comma majus.
3	5	Sixth major	
			Semitone minor.
5	8	Sixth minor	
			Semitone major.
2	3	Fifth	
			Schisme.
27	40	Fifth – Schisme	
			Semitone minor.
45	64	Semififth	
			Comma minus i.e. as 2048 to 2025. Δ
32	45	Tritone	
			Semitone minor.
20	27	Fourth + Schisme	
			Schisme.
3	4	Fourth	
			Semitone maior.
4	5	Third major	
			Semitone minor } Semitone med. as 135·128. Δ.
5	6	Third minor	
			Schisme. }
27	32	Third minor – Schisme	
			Semitone pythag. as. 256. to. 243. Δ.
8	9	Tone major	
			Schisme. }
9	10	Second minor	
			Semitone minor. } Semit max. as. 27 to 25. Δ.
15	16	Semitone major	
			Diesis minor. }
24	25	Semitone minor	
			Semitone minor.
25	10	as an Unisone, to its graver.	

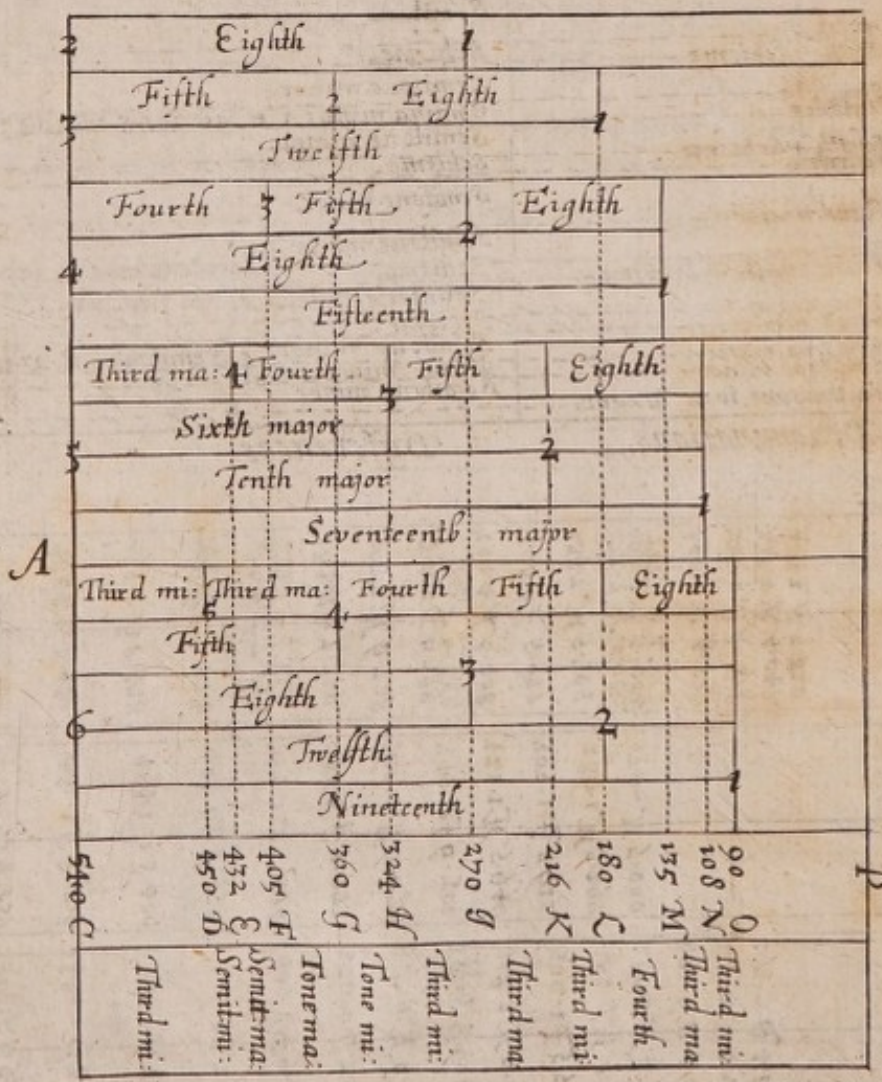
tions, Denominations, Differences.

~~540 A 10.000~~	~~540 A 10.000~~	~~540 A 10.000~~
510.3 B 9.450	509.7 B 9.439	509.2 B 9.429
482.2 C 8.929	481.1 C 8.909	480.1 C 8.891
455.7 D 8.438	454.1 D 8.409	452.7 D 8.384
430.6 E 7.974	428.6 E 7.937	426.9 E 7.905
406.9 F 7.535 / 405.9 F 7.517	404.5 F 7.492	402.5 F 7.454
384.5 G 7.120	381.8 G 7.071	379.6 G 7.029
363.3 H 6.728	360.4 H 6.674	357.9 H 6.628
343.3 I 6.358 / 339.3 I 6.283	340.2 I 6.300	337.5 I 6.250
324.4 K 6.008	321.1 K 5.946	318.2 K 5.893
306.6 L 5.677	303.1 L 5.612	300.1 L 5.557
289.7 M 5.365	286.1 M 5.297	282.9 M 5.240
273.7 N 5.069 / 269.1 N 4.984	270 N 5.000	266.8 N 4.941
258.7 O 4.790		251.6 O 4.659
244.5 P 4.527		237.2 P 4.393
231.0 Q 4.278		223.7 Q 4.142
218.3 R 4.042		
206.3 S 3.820		

Animadversions upon the

[9] *Yett, in his Second figure p. 13, y^e* Author *set's downe some* Consonances *with greater* Differences; *and page. 14. he dichotomiseth A B in to eight parts for the* Consonances, *as into 16 for both* Tones.

[10] *But more clearly this fig: following, where the Space A B is actually and distinctly diuided into 2, 3, 4, 5, & 6, æquall parts.*



[11] *All* Harmonicall Compositions *are performed by Adiitiõ of their*

their *Rations*, and Divisions by Subduction: *viz.*

Addition, by a Multiplication of the *like* Terms, or Collaterally thus =:

Substraction by a Multiplication of the *unlike* Terms, or obliquely thus X:

For Example.

$\frac{3}{4} + \frac{2}{3} = \frac{6}{12} = \frac{1}{2}$. i.e. $\nabla 4 + \nabla 5 = \nabla 8$.

$\frac{4}{3} + \frac{3}{2} = \frac{12}{6} = \frac{2}{1}$. i.e. $\Delta 4 + \Delta 5 = \Delta 8$.

$\frac{2}{3} - \frac{3}{4} = \frac{8}{9}$. i.e. $\nabla 5 - \nabla 4 = \nabla 2$ Major.

$\frac{3}{2} - \frac{4}{3} = \frac{9}{8}$. i.e. $\Delta 5 - \Delta 4 = \Delta 2$ Major.

as is visible from the divisions on the *foure Chordes* adjoyning.

[12.] As may be seen in Fig. An. 10.

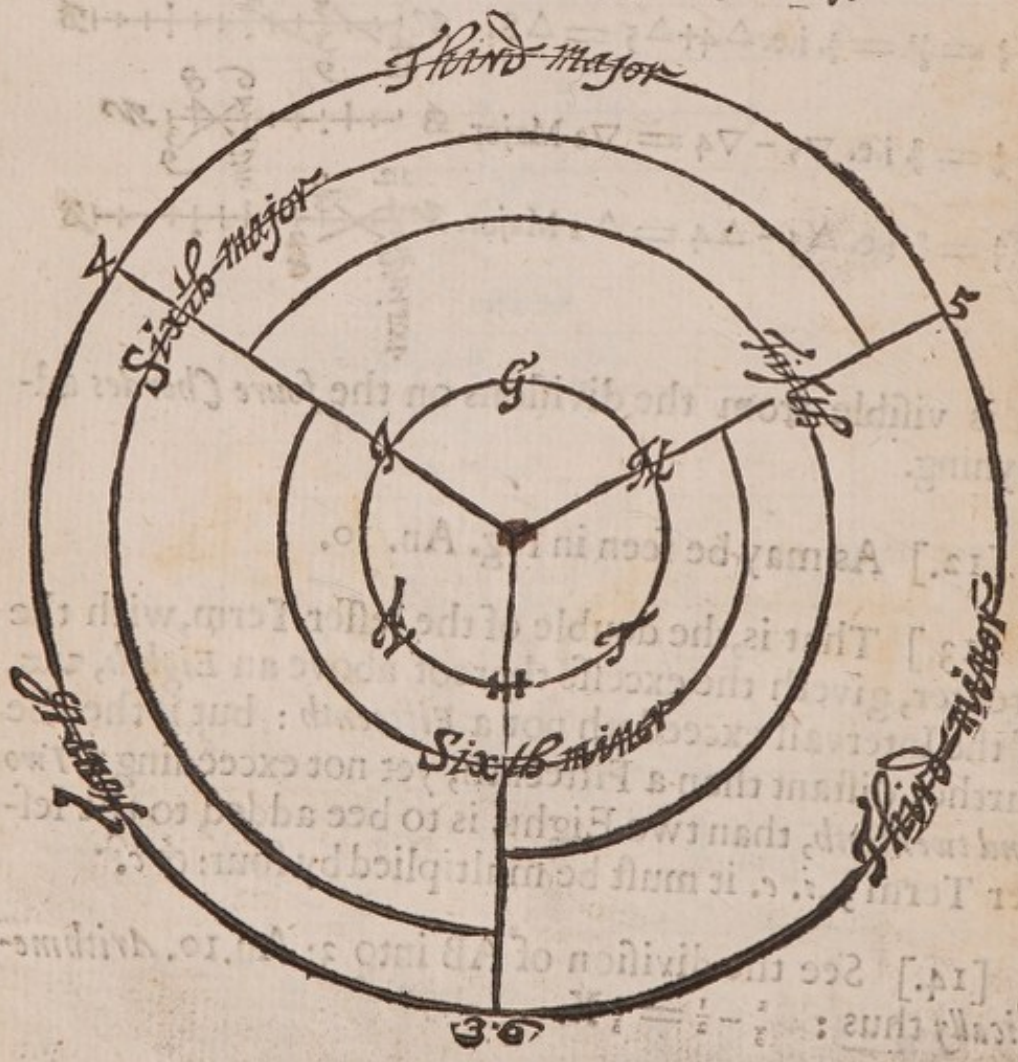
[13.] That is, the double of the lesser Term, with the greater, giveth the excesse thereof above an *Eighth*, *viz.* if the Intervall exceedeth not a *Fifteenth*: but if they be further distant than a Fifteenth, yet not exceeding a *Two and twentieth*, than two Eights is to bee added to the lesser Term; *i. e.* it must be multiplied by four: *&c.*

[14.] See the division of AB into 3: An. 10. *Arithmetically* thus: $\frac{1}{3} - \frac{1}{2} = \frac{2}{3}$ X.

[15.] *Viz.* for the graver Term. See the division of AB into 4. An. 10.

[16.] For $\frac{2}{3} + \frac{2}{3} = \frac{4}{6}$.

[17.] *Viz.* p. 9. And may be made out from the division of A B into six An. 10, if according to the method of our Authour, p. 17, wee convert one halfe thereof, *viz.* from 6 to 3 (which containeth the space of an Eighth) into the Circle following; so that the point at 6 be joyned to the point at 3, and the Circle be divided into three equally (as is 6, 3) at 4 and 5.



[18.] As $\frac{1}{2} - \frac{4}{5} = \frac{5}{8}$ X.

[19.] Or compoſed of one, or more *Eights* only, or together with ſome one that is contained therein. p. 11.

[20.] As, in Fig. 1, An. 8, is the *Eighth* on the *Chorde* B o; *viz.* o 21 at 8.

[21.] As, on the ſame *Chorde*, is 8 21 at 14.

[22.] As, on the ſame *Chorde*, is 14 21 at 17.

[23.] It ſhould have been only the *Semitone major*; for the *Semitone minor* is not to bee found without an other Subdiviſion.

[24.] *Viz.* An *Eighth*; from the firſt diviſion of AB, p. 14: a *Fifth*; from the Second: and a *Ditone* from the Third.

[25.] 2 gives the Eight; 3 the Fifth; and 5 the Third *major*: ſee alſo A B An. 10.

[26.] Here endeth the *Former Tract*, as it's called, p. 27, l. 25.

[27.] Whereof p. 55.

[28.] By *Numbers*; as in the firſt Fig. 10. by *Diviſion*; as of the line A B, p. 14.

[29.] *Viz.* the Eighth, Fifth, and Ditone as before.

[30.] *Viz.* p. 11.

[31.] For both the compounded *Ditones*, as well as the ſimple, are to be found on a Chorde underſtood to conſiſt

siſt of but five equall parts; whereas the firſt compound *Fourth* requireth 8, and the Second 16; as in the Second Fig. p.13.

[32.] Proportion is called *Multiplex*; when the greater Terme containeth the leſſer exactly twice, or oftner: *Superparticular*; when the greater containeth the leſſer once, and one certain part thereof: and *Multiplex-ſuperparticular*; when the greater doth containe the leſſer twice or oftner, and (beſides) one certain part thereof.

[33.] For, as an *Eighth*, divided equally into two parts, doth conſtitute properly a *Fifth*, and by accident a *Fourth*; ſo that *Fifth* divided into two equall parts, conſtituteth properly a *Ditone*, and by accident a *Third minor*: ſee AB Animad. 10.

[34.] For a Ditone + Fourth = Sixth *major*; a Ditone + an Eighth = Tenth *major*; and a Ditone + Fifteenth = Seventeenth *major*. See Fig. 1, p. 10, at Numbers 4 and 5; and the diviſion of AB into 5 Fig. An. 10.

[35.] For a Third *minor* + a Fourth = Sixth *minor*.

$$\frac{5}{6} + \frac{3}{4} = \frac{5}{8}.$$

[36.] *Viz.* of the Graver Term. See Fig. AB An. 10.

[37.] Note, that in every Muſicall *Syſteme*, (whereof there are two ſorts; the greater of Ten paralell Lines, and the leſſer of Five:) every Line is the ſeat of one Note, and every intervall of another, and therefore C is a Note higher than B, and G lower than E. See p. 40.

38. For

[38.] For $\frac{5}{8} - \frac{2}{3} = \frac{15}{16}$ *i. e.* $\frac{1}{16}$ of the Graver Term.

[39.] *Viz.* p.14, where CB, the space of an Eight, is divided into CE a Ditone; ED a Third *minor*; and DB a Fourth.

[40.] *Viz.* by dividing CE p.14, equally into Two, at F: or DG, Fig. An.10. at F: or 14 21 of the Chorde B o, Fig.1, An.8, at 17.

[41.] By dividing EG, Fig. An.10, at F: or 8 14 of the Chorde B o, Fig.1, An.8, at 11.

[42.] By dividing GI, Fig. An.10, at H; or EH at G: or o 8 of the Chord B o, Fig.1, An.8, at 6.

[43.] As o 6, Fig. 1, An.8, at 2.

[44.] As DG = DE, + EF, + FG; Fig. An. 10: or 14 21, = 14 15, + 15 17, + 17 21; of the Chorde B o Fig.1, An.8.

[45.] As DE, + EF = DF; Fig. An.10: or 14 15, + 15 17, = 14 17; of the Chorde B o Fig.1, An.8.

[46.] As 14 15, with 11 14; of the Chorde B o Fig.1, An.8.

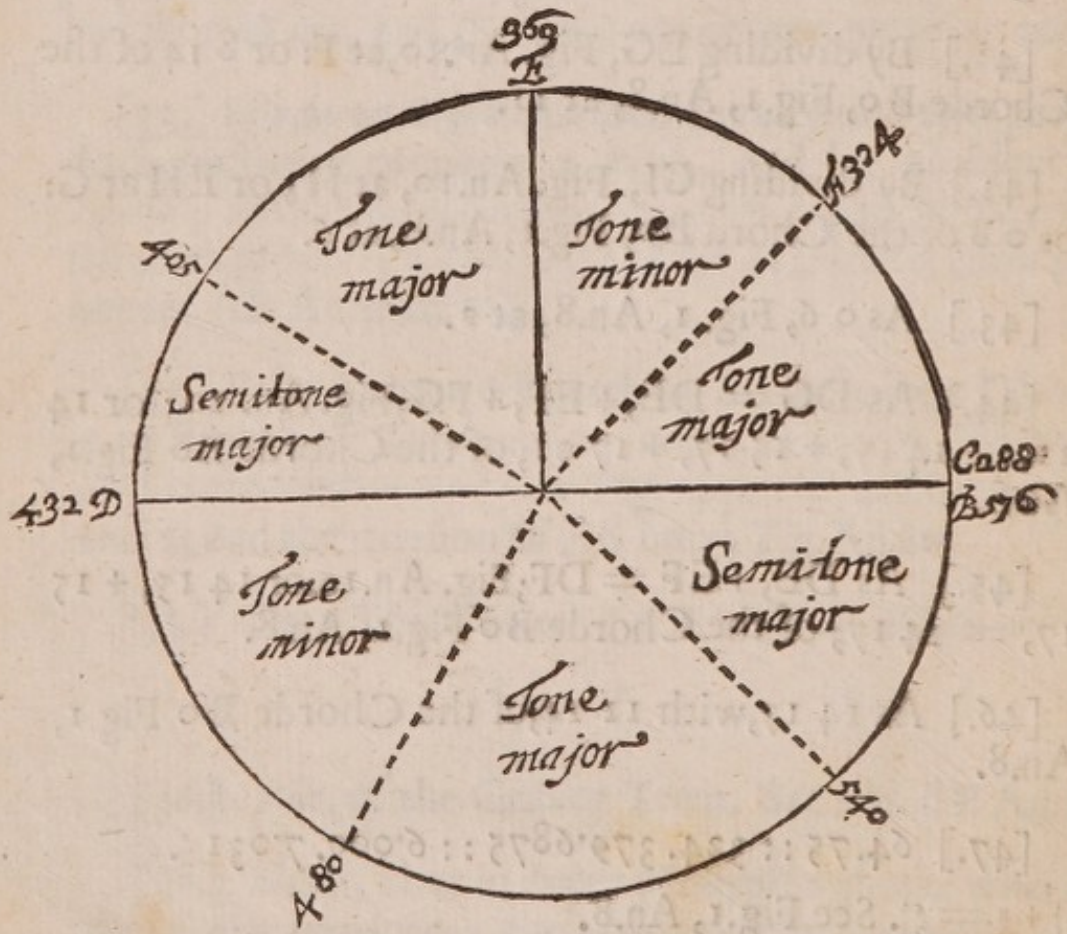
[47.] 64.75 :: 324. 379·6875 :: 6·000. 7·031 $\frac{1}{4}$.
$\frac{24}{25}^{8} + \frac{8}{9}_{3} = \frac{64}{75}$. See Fig.1, An.8.

[48.] Because a *Semitone majus* makes no *Consonance* with the other two.

[49.] Becauſe a *Tone major* maketh a *Third*, with either.

[50.] *Viz.* p. 27.

[51.] For otherwiſe a *major Semitone*, and *minor Tone* muſt fall together, as may be ſeene in this following Figure; where the ſpace of an Eighth is turned into a Circle, and divided firſt, as was CB p. 14, at D and E; and then ſubdivided as p. 27.



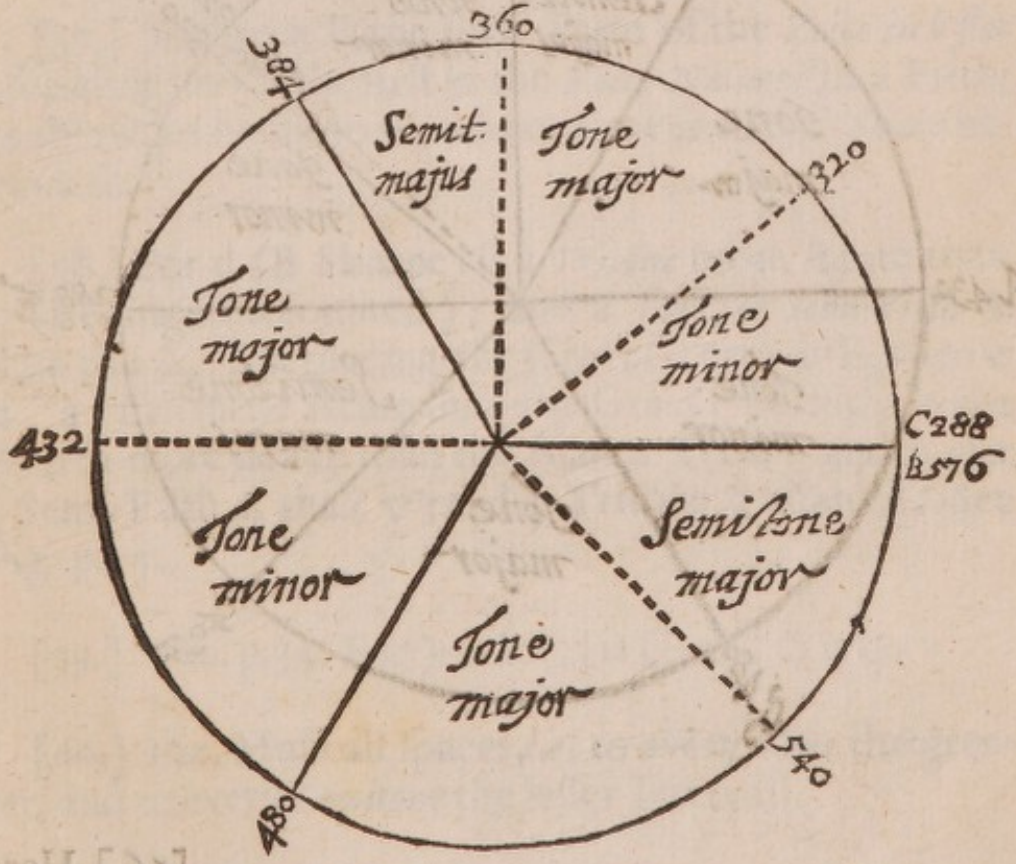
[52.] Others do call it a *Comma majus*, See Fig. 1, An. 8.

[53.] And is called *Semitonium medium*, as Fig. 1, An. 8.

[54.] Or

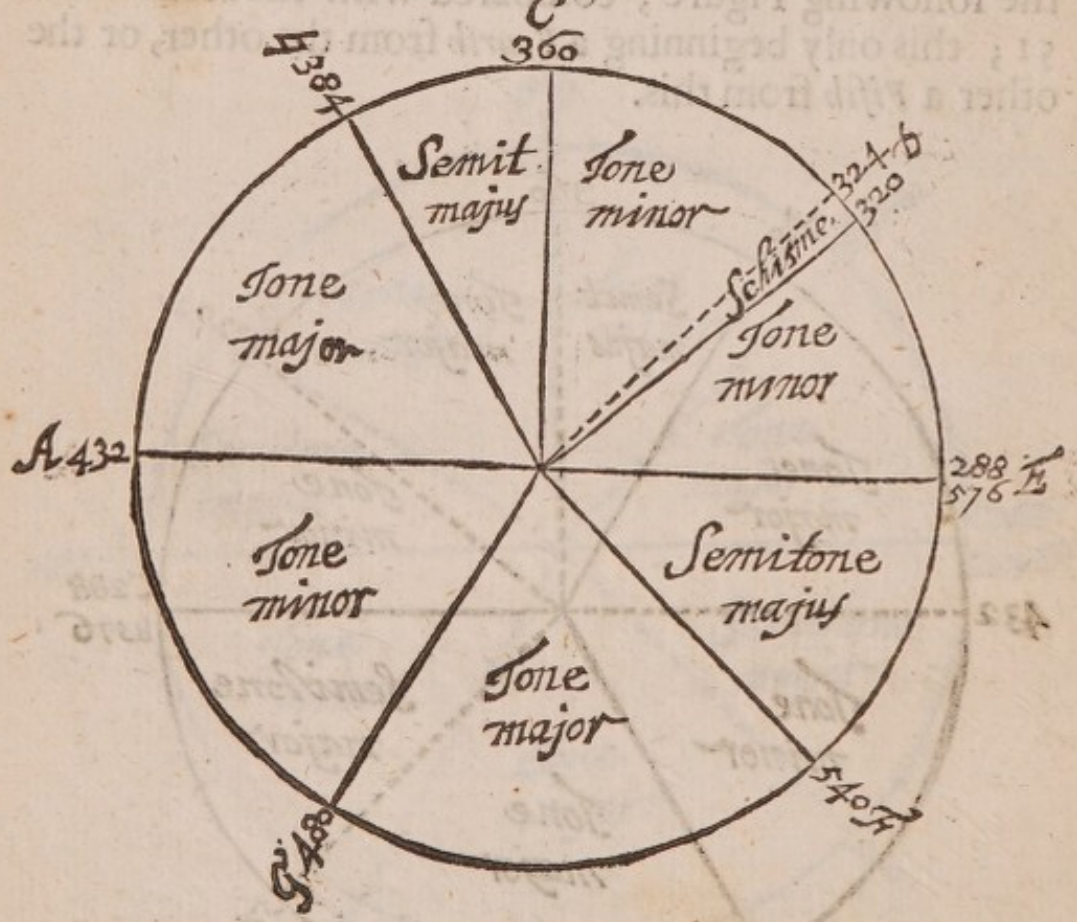
[54.] Or rather 576; because it is the *Gravest Term*, in this instance: as also according to the division of an Eighth, p. 14, and 27. See Fig. An. 51.

Note that an *Eighth*, divided first into three equall parts, by the division of the whole string into six, as p. 13; and those three then subdivided, as p. 28; doth give the Degrees in the same Order: as is to be seen by the following Figure, compared with the former An. 51; this only beginning a *Fourth* from the other, or the other a *Fifth* from this.



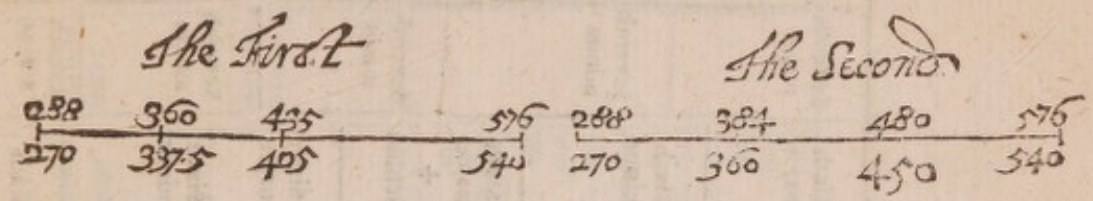
 [55.] Only

[55.] Only it seemeth as moved upon its *Center*, till the *Schisme* cometh to be between 324 and 320, as this Figure doth demonstrate; which differeth not from the last (An. 54): only in this the Schisme doth stand divided from the *major* Tone (the Intervall between 320, and 360) in that other.



[56.] Here

[56.] Here the Authour recedeth from his former division of an *Eighth*, onely by removing the *Graver Terme* from E to F: as is to bee seen by these two spaces of an



Eighth. The first divided as CB, p.14, at D and E: the Second as CI, Fig. An.10, at DG. with both which this doth accord; E, not F, being made the Graveſt Term.

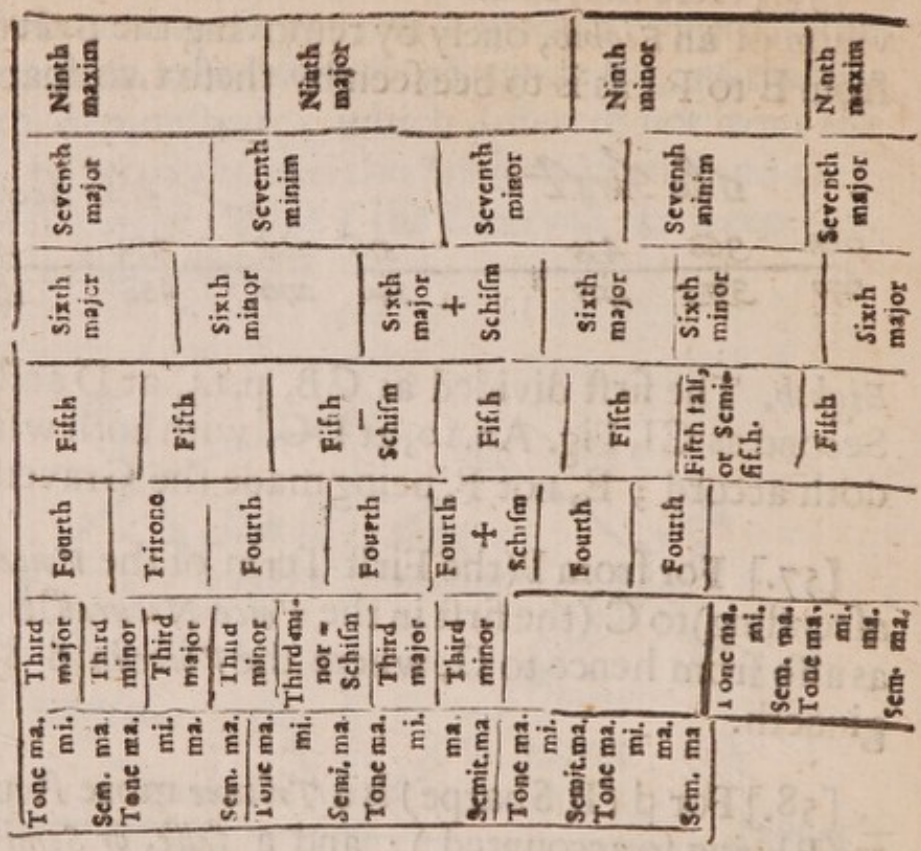
[57.] For from F (the First Term of the *Voice in b flat* ascending) to C (the first in the *Voice Naturall*) is a Fifth; as also from hence to G, where the *Voice in* ♮ *Sharp* beginneth.

[58.] For ♮ (B Sharpe) is a *Tritone* more Acute than $\overline{\nabla}$ (F being so accounted): and a *false, or Semi-Fifth* ▽ than the $\underline{\triangle}$. But placing the Graver Term at E; then is ♮, a Fifth more Acute than the Graver Terme; and a Fourth more Grave than the Acuter Term: and b flat a Semi-Fifth △ than $\overline{\nabla}$; and a Tritone ▽ than $\underline{\triangle}$. See Fig. p.35.

[59.] *Viz.* p.34. For): is F: |=| is C: and G is G.

[60.] *Viz.* Musicall spaces, *i.e.* to every *Tone* the greater, and to every *Semitone* the lesser Intervall.

[61.] As appeareth by this Figure following.



[62.] *Viz.* $\frac{128}{135}$ *Semitonium medium*, as before An. 53.

[63.] For $\frac{1}{2} + \frac{8}{9} = \frac{4}{9} : \frac{1}{2} + \frac{9}{10} = \frac{9}{20} : \frac{1}{2} + \frac{15}{16} = \frac{15}{32}$.

$\frac{1}{2} - \frac{15}{16} = \frac{8}{15} : \frac{1}{2} - \frac{9}{10} = \frac{5}{9} : \frac{1}{2} - \frac{8}{9} = \frac{9}{16}$.

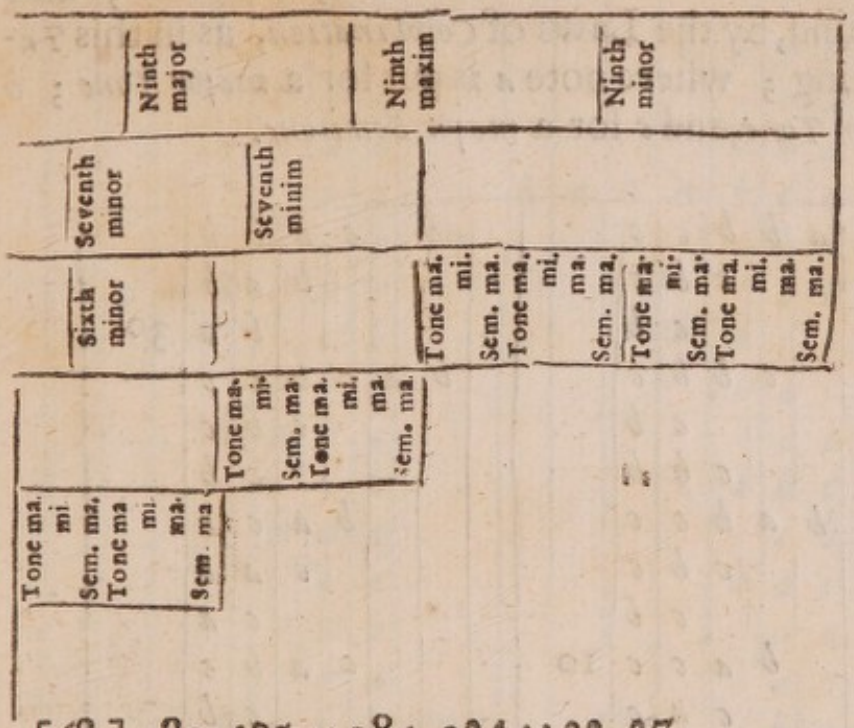
[64.] See p. 22.

[65.] *Viz.* p. 28.

[66.] See Figure An. 61.

[67.] For $\frac{1}{2} - \frac{80}{81} = \frac{17}{32} : \frac{1}{2} - \frac{40}{81} = \frac{27}{42} : \frac{1}{4} + \frac{20}{81} = \frac{20}{27} : \frac{1}{3} + \frac{80}{81} = \frac{16}{27}$.

[68.] 480.



[68.] 480. 405 :: 384. 324 :: 32. 27.
480. 324 :: 40. 27.
324. 240 :: 27. 20.
405. 240 :: 324. 192 :: 27. 16.

[69.] For $\frac{3}{4}\overset{x}{\underset{1}{+}}\frac{128}{135}\overset{32}{\underset{45}{=}}\frac{32}{45}:\frac{2}{3}\overset{x}{\underset{x}{-}}\frac{128}{135}\overset{64}{\underset{45}{=}}\frac{45}{640}$

[70.] 540. 384 :: 405. 288 :: 45. 32.
384. 270 :: 288. 202·5 :: 576. 405 :: 64. 45.

[71.] *viz.* the first compound *Eighth*, *i. e.* a *Fifteenth*.

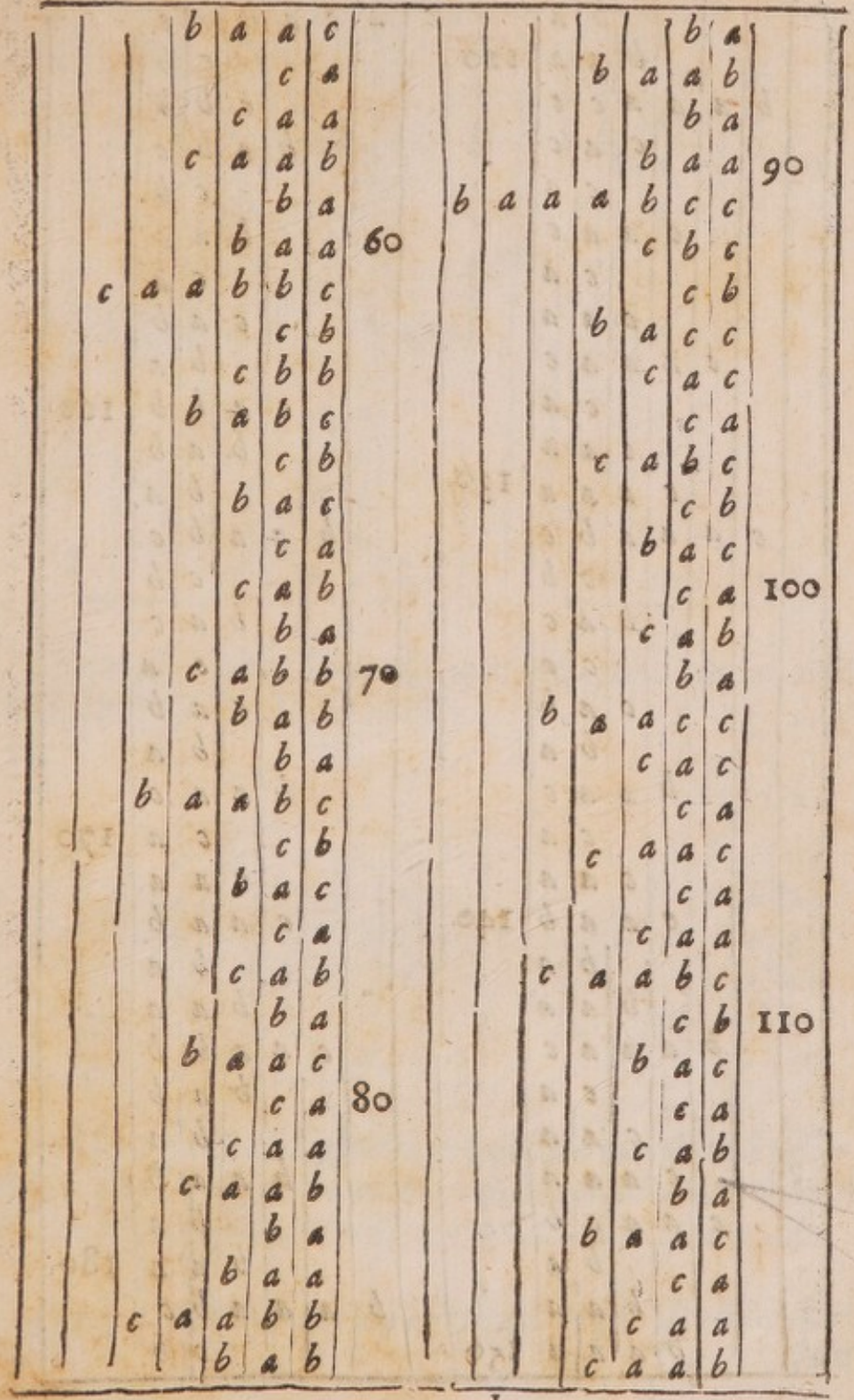
[72.] *Viz.* without altering the order of Succession, p. 30, and 41.

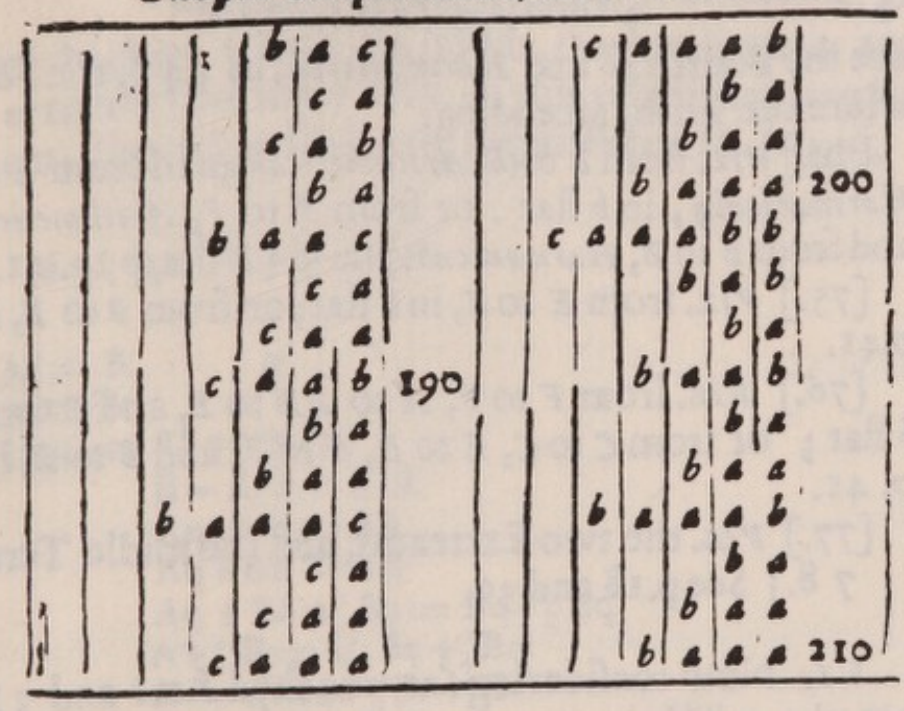
Otherwise, of Eighths considered only as consisting of three *major* Tones, two *minor* Tones, and two *major* Semitones;

mitones; there are 210 severall sorts, or *Moods*; and may be found, by the Laws of *Combination*, as in this *Table* following; where note *a* is put for a *major Tone*; *b* for a *minor Tone*, and *c* for a *major Semitone*.

a	a	a	b	b	c	c	
				c	b	c	
					c	b	
			c	b	b	c	
					c	b	
				c	b	b	
		b	a	b	c	c	
				c	b	c	
					c	b	
			b	a	c	c	10
				c	a	c	
					c	a	
			c	a	b	c	
					c	b	
				b	a	c	
					c	a	
				c	a	b	
					b	a	
		c	a	b	b	c	
					c	b	20
				c	b	b	
			b	a	b	c	
					c	b	
				b	a	c	
					c	a	
				c	a	b	
					b	a	

			c	a	b	b	
				b	a	b	
					b	a	30
	b	a	a	b	c	c	
				c	b	c	
					c	b	
			b	a	c	c	
				c	a	c	
					c	a	
			c	a	b	c	
					c	b	
				b	a	c	
					c	a	40
				c	a	b	
					b	a	
		b	a	a	c	c	
				c	a	c	
					c	a	
			c	a	a	c	
					c	a	
				c	a	a	
		c	a	a	b	c	
					c	b	50
				b	a	c	
					c	a	
				c	a	b	
					b	a	

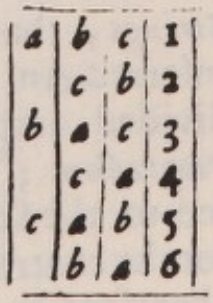

60
70
80
90
100
110



After the ſame *Method*, there are found twelve *Fifths*, and ſix *Fourths*, as followeth.

Fifths

Fourths



And therefore of *Eighths* divided into *Fourths* and *Fifths*, there are ſeventy and two ſeverall *Moods*: and thus of *Fifths*, divided into *Thirds*, there are eight *Species*: *&c.*

[73] *Viz.* both *Arithmetically*, as 2 3 4, the Fifth before

fore the Fourth; and *Harmonically*, as 3 4 6, the Fourth before the Fifth, ascending.

[74.] *Viz.* from *B* to *B*, *Arithmetically*; and from *E* to *E*, *Harmonically*, in *b* flat: or from *F* to *F*, *Arithmetically*; and from *B* to *B*, *Harmonically*, in ♮ (*B* sharp) p. 41.

[75.] *Viz.* from *E* to *E*, in *b* flat; or from *B* to *B*, in ♮. p. 41.

[76.] *Viz.* from *F* to *F*, *A* to *A*, *B* to *B*, and *E* to *E*, in *b* flat; or from *C* to *C*, *E* to *E*, *F* to *F*, and *B* to *B*, in ♮. p. 41.

[77.] *Viz.* the two Extreams, and the midle Term.

78.] See p. 18 and 30.

§ 1. Now considering (as was sayd An. 1 and 3) that not the *visible* proportion of *Chords* or *Strings*, but the *audible* proportion of their *Sounds* only is considerable in Musick; and that, by the *Sence* of *Hearing*, wee doe judge of *Sounds* according to the *Geometricall*, not Arithmeticall Proportion, or proportionall *Division* of the *Strings*, that give them: I conceive it was rightly inferred An. 3, that *Chordes*, as to Sounds, ought to bee divided according to a *Geometricall*, not Arithmeticall *Progression*; by force of the same *Reason* (adequated to the Sence of Hearing) which our *Authour* gave for the contrary opinion in his sixth Preconsiderable. It therefore remaineth that I heere shew what *Division* it is I mean, and how it may be performed.

§ 2. First then let the Chord *AZ*, Fig. 2, An. 8, be divided at *S*, into *Extream and Mean Ration*, by 30. 6. *Elem. Euclid.* or by *Prob.* 1, *f.* 19, *Clavis Mathematicæ*; which done, let *AS*, the *Mean Proportionall*, bee divided into 17 *equall Semitones*, by 16 mean Proportionals; by the Latter Table

of

of *Potestates* Chap. 12. of Mr. *Oughtreds Clavis Mathem.* or rather (the other way, in this case, being very laborious) *Chap.* 17. *Arithmetica Logarithmica H. Briggij.*

§ 3. *I perform'd it thus.*

$AZ = B$
$AS = A$
Therefore $ZS = B - A$
$B - A. A :: A. B.$
$Aq = Bq - BA$
$Aq + BA = Bq$
$Aq + BA + \frac{1}{4}Bq = Bq + \frac{1}{4}Bq$
$A + \frac{1}{2}B = \surd: Bq + \frac{1}{4}Bq:$
$A = \surd: Bq + \frac{1}{4}B: - \frac{1}{2}B$
$B = 10$
$Bq = 100$
$\frac{1}{4}Bq = 25$
$Bq + \frac{1}{4}Bq = 125$
$\surd: Bq + \frac{1}{4}Bq: = 11.18033,98875 -$
$\frac{1}{2}B = 5$
$A = 6.18033,98875 -$
$B - A = 3.81966,01125 +$

$B = 10.00000,00000$	$\overline{2}$	1,00000,00000	
$B - A = 3.81966,01125$	$\overline{2}$	0,58202,47162	
	X	0,41797,52838	
	⌐	17	
	⌐	0,02458,67814 = R	1.058 +
$\overline{2}$ B - A		0,58202,47162 = ZS	3.820 -
⌐ + ZS		0,60661,14976 ZR	4.042 +
ZR		0,63119,82790 ZQ	4.278 -
ZQ		0,65578,50604 ZP	4.514 -
ZP		0,68037,18418 ZO	4.790 +
			⌐ + ZO

ZO	0,70403,86332	ZN	5'0694
ZN	0,73954,54046	ZM	5'365 -
ZM	0,75413,21860	ZL	5'6774
ZL	0,77871, 89674	ZK	6'008 -
ZK	0, 80330, 57488	ZI	6'358 -
ZI	0, 82789, 25302	ZH	6'718 +
ZH	0, 85247, 93116	ZG	7'120 -
ZG	0, 87706, 60930	ZF	7'535 -
ZF	0, 90165, 28744	ZE	7'974 -
ZE	0, 92623, 96558	ZD	8'438 +
ZD	0, 95082, 64372	ZC	8'9'94
ZC	0, 97541, 32186	ZB	9'450 -
ZB	1, 00000, 00000	ZA	10'000

§ 4. Into *Extreame and meane Ration*; that the parts and whole may be ⋕. ZS. SA : : SA. ZA.

§ 5. Into *Seventeen equall Semitones*; because (the Ear not well distinguishing smaller Intervalls) this *Number* doth best admit of the subsequent *Divisions*, proportionall to their *Extreames*; whence the *Consonances* doe naturally arise, according to this *Analogy*, *viz.* As the number of parts in the First Terme, is to the number of parts in the Third; so the number of Rations between the First and Second, to the number of Rations between the Second and Third. And may bee work'd by either of the following Rules.

In Naturall *Numbers.*

First Rule. ≙ ⌐ ✓ [≙/▽] ✕ [≙] R = Second Terme.

Second Rule. ▽ ⌐ ✓ [≙/▽] ✕ [▽] R = Second Terme.

In

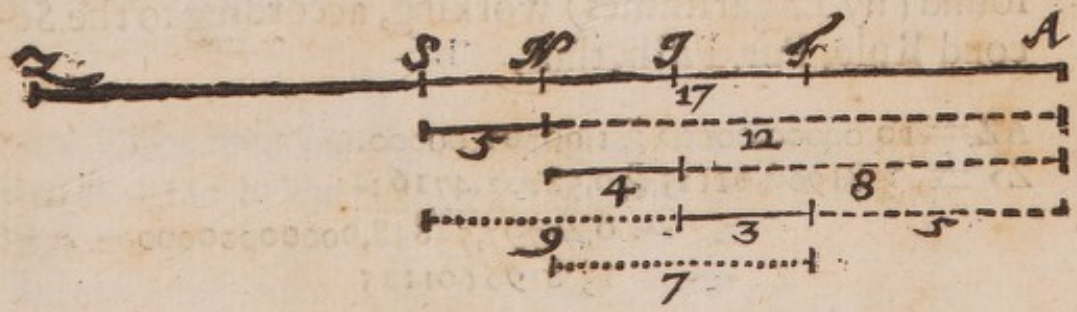
In Artificiall *Numbers, or Logarithmes.*

First Rule. $b + \frac{aB - bB}{A + B} =$ Second Terme.

Second Rule. $a - \frac{aA - bA}{A + B} =$ Second Terme.

Note $\frac{\triangle}{\nabla} = \overline{\nabla} + \underline{\triangle} : A = \overline{\nabla} : a = \frac{3}{4}\overline{\nabla} : B = \underline{\triangle} : b = \frac{3}{4}\underline{\triangle}$.

§ 6. For, from this Division, of the Intervall of an *Eleventh* (*i.e.* the Meane Proportionall AS); ariseth an Eighth, and a Fourth: of an *Eighth*; a Sixth *minor*, and a Third *major*: and of a *Sixth minor*; a Third *minor*, and a Fourth. and these compounded give the rest.



ZS. ZA :: 5 Semit. 12. *fere.*
ZN. ZA :: 4. 8. *fere.*
ZI. ZA :: 3. 5. *fere.*
Third *minor* = 3 Semitones.

Third

Third *major* = 4 Semitones.
Fourth = 5.
Fifth = 7.
Sixth *minor* = 8.
Sixth *major* = 9.
Eighth = 12.

This Proportion or Progression, from its excellency and composion, I call Ratio-harmonicall.

§ 7. It may bee objected that the Rx of ZS to ZA is 2·61803398875 –, that is as 5 to 13 +; and therefore SA ought rather to have been divided into 18 proportionall parts, by 17 Meane Proportionalls: whereof 5 = Intervall of a Fourth; and 13 = Space of an Eighth.

§ 8. To which I answer, that SA is understood to bee divided into 13·81966,01125 + Proportionall parts: (because the Rx of ZS to ZA, *viz.* 2·61803398875 –, is as 3·81966,01125 + to 10·00000, 00000.) whereof the space of an *Eighth* containeth 10·00000, 00000; and of a *Fourth* 3·81966, 01125 +. *&c.* And may bee easily found (by Logarithmes) working, according to the Second Rule, Par. Fifth, thus.

AZ = 10·00000,00000 ℨ 1,00000,00000.
ZS = 3·81966,01125 ℨ 0,58202,47162.
0,41797,52838,00000,00000.
13·81966,01125
0,30244,97566.
0,69755,02434. = ZN, 4·98368,11082.

AZ = 10·00000,00000 ℨ 1,00000,00000.
ZN = 4·98368,11082 ℨ 0,69755,02434.
0,30244,97566,00000,00000.
14·98368,11082
0,20185,27720.
9,79814,72280. = ZI, 6·28271,31146

ZA

ZA = 10·00000,00000 ∛ 1,00000,00000.
ZI = 6·28271,31146 ∛ 0,79814,72280.
0,20185,27720,00000000000.
16·28271131146
0,12396,75296.
0,87603,24704. = ZF, 7·51679,09302

§ 9. But this exactneſſe is not requiſite, ſince the *Senſe* of *Hearing* is not ſo perfect, as to confine the *Conſonances* to ſo preciſe a *Meaſure*; (ſee p. 46.) and therefore, ſeeing that SA divided into 17 Proportionall Spaces, doth give (without any *Fraction*, or ſenſible difference,) all the ſimple *Conſonances*; & that $\frac{38\cdot1966+}{100\cdot0000} = \frac{4\cdot7745+}{12\cdot5000}$ that is, without Fraction, $\frac{5}{12}$; as becauſe, if SA be divided into 18 Proportionall *Intervalls*, NA (containing 13 of them) cannot bee divided at I without a *Fraction*, much leſſe again at F, I made 17 ⌐ Par. 3. with which the common *Diviſion* doth not ill accord; for ſo many *Semitones* are contained in an *Eleventh*.

§ 10. Thus then having reſolved that the *Proportion* of ZS to ZA is, as to the practick, exactly enough accounted as 5 to 12: It muſt follow, by force of the preceeding Rules Par. 5. that (1) the *Product* of 3·81966, 01125 *Multiplyed* by the Seventeenth *Roote* of the Fifth *Poteſtas* of 2·61803398875; or (2) the *Quotient* of 10·00000, 00000 *Divided* by the Seventeenth *Roote* of the Twelfth *Poteſtas*, of 2·61803398875 = ZN. And by *Logarithmes* as followeth.

AZ = 10·00000,00000	♐	1,00000 00000	
ZS = 3·81966,01125	♐	0,58202,47162	
	X	0,41797,52838	0,41797,52838
	♒	5	12
	♑	2 08987,64190	5,01570,34056
	⌐	17	17
	¬	0,12293,39070	0,29504,13768
	♐△	0,58202,47162	▽ 1,00000,00000
	Z	0,70495,86232	X 0,70495,86232

the *Logarithme* of (ZN) 5·069+. differing from the former, Par. 8, about the *Intervall* of a *Schisme*, or *Comma majus*, no preceptible *Dissonance*, as p. 33.

§ 11. Then ZN being to ZA, as 1 to 2 *fere*; therefore, by the Second Rule in Logarithmes, Par. 5.

♐ ZA	1,00000,00000	
ZN	0,70495,86232	
	0,29504,13768	
	2	
	0,59008,27536	
	3	
	0,19669,42512	
	1,00000,00000	
	0,80330,57488	♐ ZI, 6·358

§ 12. Lastly ZI and ZA being as 3 to 5 *fere*; therefore

♐ ZA	1,00000,00000	
ZI	0,80330,57488	
	0,19669,42512	
	5	
		0,98347

0,98347,12560
8

0,12293,39070
1,00000,00000

0,87706,60930 ℥ ZF, 7535-

§ 13. *With what hath been here said, if the Reader please to be satisfied at present; I shall, when, if ever, I have* (God mercifully assisting) *laboured through my tedious Troubles and Distractions, endeavour his better compensation with an entire and particular* Tract, *according to this new* Theory. (*And hence too shall shew how* Astrologers *may deduce their* Aspects; *with more, I presume, of satisfaction, than from any other hitherto discovered to them. And perhaps with somewhat else more worthy the Reader's paines, and mine.*) *If not; I here further present him the two following* Divisions *of a* Chord, *and will so leave him to seeke it there, or where else he pleaseth.*

§ 14. The *One* (approved by many Excellent Mathematicians; See *Mersennus Lib.* 1. *de Instrumentis Harmonicis, Prop.* 15.) is the *Division* of ZA, Fig. 3, An. 8, first into two equall parts at N; and then of NA into twelve equall *Semitones*, by eleven *Meane Proportionalls*, according to this *Table* following.

	In Species,	*Numbers Surde,*
ZN	E = △. ZN.	5.000
ZM	√ 12 AEcccq.	√cccc 48828125o.oocoooooooo,ooo ooooocooo,oc oocc oooccc
ZL	√ 6 AEcq.	√cc 3125o oooooo,oooooo,oooooo
ZK	√ 4 AEc.	√qq 1250. cooo,ocoo,oooo
ZI	√ 3 AEq.	√c 25o.ooo,ooo,ooo
ZH	√ 12 AcqEcqq.	√cccc 781250000o. ocooooooooco,ooo oooooooo,oooocoooooo
ZG	√ AE.	√ 50. oo oo, oo
ZF	√ 12 AcqqEcq.	√cccc 3125oooooo. oooooooooooo,oo oooooooooo,oooooc ooooo
ZE	√ 3 AqE.	√c 5oo. ooo, ooo, coo
ZD	√ 4 AcE.	√qq 5ooo. ooo, oooo oooo
ZC	√ 6 AcqE.	√cc 500000. oooooo,oooooo,oooooo
ZB	√ 12 AcccqE.	√cccc 5oooooooooo. oooooooooooo,o oooooooooo,oooooooooo
ZA	A = ▽. ZA.	10.000

	Logarithmes,	*Numb. D.*
ZN	o, 69897, ooo43.	5'000
ZM	o, 72405, 58372.3	5'297+
ZL	o, 74914, 16702.2	5'612+
ZK	o, 77422, 75032.1	5'946+
ZI	o, 79931, 33362.	6'300-
ZH	o, 82439, 91691.3	6'674+
ZG	o, 84948, 50021.2	7 07 +
ZF	o, 87457, o8351.1	7'492-
ZE	o, 89965, 66681.	7'937+
ZD	o, 92474, 25010.3	8'409-
ZC	o, 94982, 83340.2	8 909-
ZB	o, 97491, 41670.1	9'439-
ZA	1, 00000, 00000.	10'000

§ 15. The

§ 15. The *Other* is the Division of ZA, Fig. 4, An. 8, *Harmonically* at Q: and of QA into 15 equall *Semitones*.

The manner thus.

ZA = B
ZQ = A
Therefore QA = B − A

A.B : : B − 2A.A.		B = 10.
Aq = Bq − 2BA		Bq = 100.
Bq = Aq + 2BA		2Bq = 200.
2Bq = Aq + 2BA + Bq		√:2Bq: = 14·1421+
√:2B: = A + B		A = 4·1421+
√:2Bq: − B = A		B−A = 5·8579−

B = 10. 000 ∛ 1, 00000, 00.
A = 4·142+ ∛ 0. 61722, 48.
X 0, 38277, 52.
⌐ 15.
⌐ 0, 02551, 83 $\frac{7}{11}$ = Rx 1·061−

∛ A	0, 61722, 48.	= ZQ 4·142+
⌐ +ZQ	0, 64274 31·7	ZP 4·393−
ZP	0, 66826. 14.14	ZO 4·659−
ZO	0, 69377. 98.6	ZN 4·941−
ZN	0, 71929. 81.13	ZM 5·240−
ZM	0, 74481, 65.5	ZL 5·557−
ZL	0, 77033, 48.12	ZK 5·893−
ZK	0, 79585, 32.4	ZI 6·250−
ZI	0, 82137, 15.11	ZH 6·628−
ZH	0, 84688, 99 3	ZG 7·029−
ZG	0, 87240, 82.10	ZF 7·454+
ZF	0, 89792, 66.2	ZE 7·905+
ZE	0, 92344, 49.9	ZD 8·384−

⊐ + ZD	0,94896,33.1	ZC	8·891 +
ZC	0,97448,16.8	ZB	9·429 +
ZB	1,00000,00.	ZA	10·000

§ 16. And lastly, that the *Reader* may, with the lesse trouble, compare these severall *Divisions* each with other; I have both reduced our *Authours* Numbers to these, and these to his. See Fig. 1, 2, 3, and 4. An. 8.

FINIS.

P.	L.	These Errors	Amend thus.
3	16	,[5]	[5],
7	24		
	25		
	26		
8	6	Conſonancies	Conſonances
11	25		
	26		
12	1		
	24	Hexarhordon minus,	Hexachordon minus,
17		Eight	Eighth
	2	Diapaſſon	Diapaſon
19	13	an Eighth [26].	[26] an Eighth [26].
18	30	o Fi dne	a Fifth, and
21	1	deſumded	deſumed
22	6	For Example,	
23	6	than betweene	than, for Example, betweene
	7		
25	10	Muſicions	Muſicians
34	8	Muſitians	
44	13	obſerved, that a voyce [65] doth	obſerved [65], that a voice doth
	30	Syncoa. p	Syncopa.
53	19	a Eighth,	an Eighth.
54	30	a Vniſon.	an Vniſon.
55	3		
65	22	▽	▽
	23	△	△
69	18	Eights	Eighths
71	2		
	14	Eight	Eighth.
73	2		Superior Tractate,
72	16	Former Tract,	Fig. p. 10.
	19	Fig. 10	10; and thoſe three then ſubdivided,
75	6	13; and thoſe three then ſubdivided, as p. 28;	as p. 27.
78	7		
84	8	A to AB to B,	A to A, B to B,
85	3	Chap.	Cap.