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Harald

A full-length portrait of Harald Vallerius, a 17th-century Swedish scholar. He is depicted from the waist up, wearing a brown academic robe over a white shirt with a ruffled collar and a patterned vest. He has long, dark, curly hair and a serious expression. His right hand is resting on a book or document. The background is dark and indistinct.

The Music Theory of Harald Vallerius

Three Dissertations from 17th-century Sweden

by
Peter Sjökvist

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Cover picture:

Harald Wallerius, 1713, by Jan Kloppert (1670–1734).

Oil on canvas, 84 x 69,5 cm. Uppsala University Art Collections.

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ISSN 0562-2859

ISBN 978-91-554-8460-6

Printed in Sweden by Elanders, 2012.

Distributor: Uppsala University Library, Box 510, SE-751 20 Uppsala
www.uu.se, acta@ub.uu.se

Acknowledgements

During my work with Vallerius's dissertations I have received valuable remarks, advice and assistance from a considerable number of scholars, both Latin philologists and musicologists, and I am most thankful to all of them. In particular, however, I want to express my deep gratitude towards Professor Hans Helander, with whom I have always been able to discuss difficult passages in the texts, and who read parts of my book before publication. So too did other philologists, and I would like to cordially thank them here as well; Doctor Krister Östlund, Doctor Anna Fredriksson, and Doctor Erik Bohlin have all given important suggestions on improvements and necessary corrections. Parts of the texts have also been discussed at the Latin seminar at Uppsala University, under the kind direction of Professor Gerd Haverling.

Several musicologists attended these seminars as well, and I would not have been able to bring the present work to conclusion without their continuous support and enthusiasm for my project. In particular I want to thank Associate Professor (*docent*) Lars Berglund; Doctor Mattias Lundberg; and doctoral student Maria Schildt, all of whom also benevolently read the entire text before publication, and offered both good remarks and wise advice. Doctor Kate Maxwell has corrected my English, with a good portion of both patience and skill.

The project was carried out within a post-doctoral position in neo-Latin at the Department of Linguistics and Philology at Uppsala University. Additional financial support was generously granted by the J Tranérs stipendiestiftelse at Uppsala University, Birgit och Gad Rausing's Stiftelse för Humanistisk Forskning, and Helge Ax:son Johnsons stiftelse. A final part of the work was carried out at the Swedish Institute in Rome thanks to a grant from H F Sederholms stipendiestiftelse at Uppsala University. The publication has been made possible through financial support from Redaktionskommittén för Acta Universitatis Upsaliensis as well as from the Swedish Research Council (Vetenskapsrådet).

Peter Sjökvist

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1 Introduction

He [Vallerius] demonstrated his ability in an excellent way in mathematics defending a thesis on a subject that has hitherto not been treated. He has studied so well that he can win the degree any day he wants to, yes have a profession. He is so perfect in music, that he composes very well ... He plays his viol, shawm, curtal, sackbut, flute perfectly, and so perfectly a thorough bass ... [He] is a pious and quiet young man, *rara avis in his terris* ...¹

When Harald Vallerius as a 28-year-old student defended his dissertation on sound the morning of 4 November 1674 in the largest lecture hall of the Uppsala University main building, this was in many ways a quite ordinary academic occasion. Ever since the foundation of the university, public disputations had been an integral part of its activity. Young students thereby proved their argumentative and rhetorical skills in front of an audience of scholars and comrades, either as an exercise as a first major step in an academic career, or as a final test for winning the master's degree. In advance of the event theses were printed, in which the questions and subjects to be discussed during the oral defence were presented, and they had been published in this way in Uppsala since the beginning of the 17th century. On the shelves of our libraries they still testify in great number to the huge importance of this system in the early modern university. The growth of knowledge and the scientific progress of the time is there reflected better than in most other material.

On 4 November 1674, however, several circumstances made this occasion stand out from the rest. The respondent was in this case unusually talented, both intellectually and as a practicing musician, and he would end his days as an appreciated professor of mathematics at Uppsala University. He had therefore, in spite of his rather humble origins, gained the support and patronage of two of the most influential characters in Uppsala and Sweden during the 17th century, viz. the professor Olof Rudbeck, who was also an active musician himself, and the Chancellor of the Realm Magnus Gabriel

¹ Den [Vallerius] wiste sit wakra prof i Mathesi genom en sådan disputation, den aldrig här för war disputerat. Han haffwer så wäl studerat, att han kan wadh dagh han wil taga gradum, ia förstå en profession. Uthi Musicis så perfect att han componerar heel wäl ... Han spelar sin viol, skalmelia, dulcian, basun, vloit perfect, och så perfect en general baass ... [Han] är en gudhfruchtig stilla och from dräng, *rara avis in his terris* ... Letter from Rudbeck to De la Gardie, dated 15 October 1675. Printed in *Bref af Olof Rudbeck d.ä. rörande Upsala Univer-sitet*, vol. II (1899), pp. 120 f.

De la Gardie. Although lectures in music had taken place much earlier, a musical subject had not, as far as we know, been treated in any dissertation and disputation in Uppsala until that very day. In the letter of recommendation quoted above, written by Rudbeck to De la Gardie almost a year later, Rudbeck praises Vallerius highly in all ways, and cannot refrain from stressing the uniqueness of the enterprise. Indeed, no other texts dealing with music theory had been printed in Sweden before Vallerius's first dissertation, except for some brief manuals intended for school boys.² The printed thesis together with the disputation on sound in 1674 thus *de facto* constitutes a major event in the introduction of questions pertaining to music theory in learned discourse in Sweden.

Within two intervals of twelve years each after *De sono*, two more dissertations on music theory would be published in Uppsala, both related to Harald Vallerius. Taken together they comprise the most important aspects of sound, of the modes and of *tactus*, and three centuries later the Swedish music historian Carl-Allan Moberg stated that the three dissertations make up a 'noteworthy *Summa musicae* in the older Swedish literature' (*im älteren Schrifttum Schwedens eine beachtenswerte Summa musicae*).³ For natural reasons they were regarded as highly interesting by scholars who, just like Moberg, endeavored to understand the theoretical background of Vallerius's musical thinking, especially since he had been the editor of the Swedish hymnal of 1697, as we shall see.⁴

In spite of these recurring efforts to summarize and discuss their content, the dissertations have remained basically inaccessible to scholarship. Although physically present in several libraries in Sweden and abroad, material of this kind usually lies well hidden within collections in libraries and archives, and lacks adequate modern cataloguing. Another obstacle for research in our time is of course the circumstance that the dissertations were all written in Latin. Since Latin is no longer part of the standard scholarly curriculum, this fact alone causes difficulties enough. This is also an important reason for the publication of the present edition with introduction, translation and commentary.

The primary aim of this study is thus on the one hand the very establishment and reproduction of the Latin texts, which as already intimated had been transmitted in printed copies in the 17th century, and on the other the presentation of an adequate and well-founded English translation. The interpretation of treatises written in scientific neo-Latin that deal with music theory is an intrinsically interdisciplinary activity, and my intention has been to

² Laurentius Laurinus's *Musicae rudimenta pro incipientibus necessaria* (1622), and a chapter in Johannes Gezelius's *Encyclopedia synoptica* (1672) entitled "Musica" (pp. 566–576). Cf. Fransén 1940, pp. 61 ff. and 455 ff.

³ Moberg 1966, cols. 1242 f. Cf. Norlind 1900, pp. 191 f.

⁴ Most important are Moberg 1929, pp. 69 f.; Fransén 1940, pp. 76 ff. and 119 f.; Hansson 1967, pp. 55 ff.; and Göransson 1992, especially pp. 46 ff.

shed some light even on their basic ideas and concepts, with the assistance of learned colleagues from other disciplines. At some instances we shall nevertheless deliberately leave aside aspects that pertain more specifically to music theory and to the history of sciences and ideas, saving these for scholars specializing in those disciplines. The focus here is on more purely philological matters, even though philology should be understood in a broad sense.

In principle, the commentary primarily strives to provide the information that is needed for a plausible interpretation of the text. This includes, for instance, notes on linguistic, historical and biographical peculiarities, as well as on the relation of the texts to their various sources, when these have been located and verified. References to further reading will often serve as a substitute for more detailed discussions of well-known and generally characteristic features of music theory of the time.

First of all, however, the system of early modern academic disputations and dissertations shall be briefly discussed. The value and importance of treatises belonging to this genre have been stressed with strong supporting arguments by a growing number of researchers in recent decades, in contrast to the disinterest of previous generations of scholars.⁵

1.1 Disputations and Dissertations⁶

It is all too easy to consider the extant dissertations from the early modern university in the light of academic theses that are produced in our own time, and then to hardly be impressed by what is seen. Winning a doctor's degree, or a master's in the philosophical faculty, by defending a dissertation that comprises only some few pages in the quarto format does not really correspond to our expectations of scholarly work and its results, and the differences call for a discussion. Two circumstances are of special importance in this respect.

To begin with, in the 17th century *the oral disputation was generally more important than the written thesis*, and the printed dissertation came about primarily as a basis for the oral defence.⁷ Its original function was merely to announce the theses that would be defended. Thus it was a kind of occasional writing, the quite expensive printing of which the respondent had to pay, often with the aid of patrons and other benefactors. Sometimes the text itself

⁵ Cf. e.g. Östlund 2007, p. 151; and Gindhart & Kundert 2010, p. 1.

⁶ There are now several surveys and general discussions of early modern disputations and dissertations of relevance to Swedish universities. Most important among these are Horn 1893; Annerstedt, vol. II:2, pp. 121–131, and III:2, pp. 169–202; Sellberg 1972; Lindroth 1975, II, pp. 30–35, and III, pp. 31–33; Klinge 1988, pp. 382–417; Lindberg 1990 and 2006; Marti 1994 and 2010; Clark 2006, pp. 68–92; and Östlund 2007. An English overview can be found in Östlund 2000, pp. 14–19. Of these, the following account relies most heavily on Lindberg 2006.

⁷ Cf. Gindhart & Kundert 2010, pp. 17 f.

was elaborated to a degree that much surpasses the average (as in our case), containing both individual research, original thoughts and new insights. But proving argumentative skills publicly in Latin remained the essential issue. Related to this circumstance is therefore the fact that we cannot always be sure of who actually wrote the dissertation. The praeses could do it, the respondent could do it, and sometimes even someone else.⁸ The name of the author certainly was not of great significance, when the oral defence of the text was the most important element.

Secondly, the function of the university in the 17th century was still primarily the *teaching of what was already known*, rather than research into what was not.⁹ Exceptions do occur, including at various points in the theses presented here, but as a general principle this also holds true for the dissertations, which thus essentially reflect the prevailing scholarly ideas. This view has also been expressed regarding academic treatises on music theory from the period:

Auch sonst bieten die akademischen Beiträge zur 'barocken' Musiktheorie wenig Neues. Ihre Verfasser schöpften aus dem Fundus allgemeinen Wissens oder aus den noch vorzustellenden großen Abhandlungen.¹⁰

Such a general statement does not mean, however, that the texts cannot contain new knowledge, for several reasons.¹¹ The century was dynamic, and familiarity with the *most recent* international literature on the subject is often visible in the material (as in our case). Seen in this light, many dissertations can be considered to have come from the forefront of research, in spite of not reporting any original research themselves.

If these circumstances are crucial for understanding the general prerequisites of the system, and the presence of the many short and unimpressive dissertations, it is just as important to emphasize that treatises of the genre could be of a much higher quality, in terms of both content and extent. For they were still printed publications, with all the possibilities that this included. In a society where the system of patronage was well-established, dissertations were not only a place where the clients could demonstrate their capabilities, but where they could also publicly express their praise and gratitude to their patrons. In addition, high-quality dissertations were used both for pedagogical purposes, in teaching and as exemplars, and were dissemina-

⁸ See also section 1.4 below.

⁹ Cf. Freedman 2010, p. 90.

¹⁰ Braun 1994, p. 10.

¹¹ Cf. Marti 2010, p. 65 f.: *Deshalb gewinnt man in der Retrospektive oft genug den Eindruck, als hätten die frühneuzeitlichen Disputationen nur Erinnerungswissen vergegenwärtigt, gefestigt, kultiviert und konserviert. Andererseits ist das kritische und innovative Potenzial frühneuzeitlicher Dissertationen nicht zu unterschätzen, auch weil sie einen Meinungsstreit buchstäblich inszenierten und weil unter dem Schein der Fiktion unkonventionelle Meinungen vorgebracht und verteidigt werden konnten.*

ted among the learned society in the country and, to some extent, abroad. For the latter function the comparatively limited book-market in Sweden was supposedly an important issue. For a long time dissertations in Sweden were quite simply the most natural and convenient forum for the publication of scientific writings.¹² Since the printing costs were paid by the respondents, professors could thereby even publish their own texts by letting some students defend parts of them in disputations.

In order to be able to earn the degree a student had to defend dissertations at two different times. The first was the *pro exercitio*, which was needed for the preparatory *filosofie kandidatexamen* (BA); the second was the *pro gradu* for the Master's title. Occasionally dissertations were defended *pro loco*, when an applicant proved himself publicly for a position at the university. What mattered for the respondent at all times was to demonstrate in Latin the dialectic skill acquired during his studies. Against the theses presented in the dissertation, an opponent proposed other contrary ones, and through this discussion of theses *pro* and *contra*, in its purest form, true knowledge was supposed to be retrieved. The act was supervised by the *praeses*, who was usually a professor at the university.¹³

The purposes of the disputations were, however, not only to display dull exercises in argumentation. It was a festive occasion, often followed by a party, and useful for performances of different kinds. As we shall see below, Harald Vallerius at the defence of *De modis* illustrated the presented theses on the affect-rousing¹⁴ effect of music with a live example. The *corollaria* that can be found at the end of the dissertations in the present edition should also be understood in this light. Their presence testifies to the possibility of also adding an element of pure entertainment at the occasions of academic disputations.

In this way disputations took place on a wide range of topics when Harald Vallerius defended his exercise dissertation on sound in 1674. Considering the position of music within the medieval academic quadrivium,¹⁵ however, it could appear somewhat surprising that no disputations on music theory had taken place at Uppsala University until this very time. Only through a sketch of the history of the subject in Uppsala can the impact of Harald Vallerius's activity be reasonably estimated.

¹² Lindberg 2006, pp. 122 and 126.

¹³ For a more detailed description of the disputation act, see Östlund 2000, pp. 15 f.; and 2007.

¹⁴ Although Palisca, and many with him, prefers 'affection' and 'passion' to 'affect' in English, since this last is allegedly "merely an anglicized form of the German *Affekt* but also carries modern psychological connotations" (2006, p. 182), I shall consistently use 'affect' in this study. This will be done "in order to avoid the modern connotations of the term 'affection'" (Sarjala 2001, p. 17). 'Affect' is of course also more closely etymologically related to the Latin *affectus*, which is the word that Vallerius and most other authors of his time use.

¹⁵ On this position and its philosophical background, see e.g. Gouk 1999, pp. 81 ff.

1.2 Music Theory at Uppsala University

The inclusion of music in the four traditional mathematical arts, i.e. arithmetic, geometry, astronomy, and music, is also the main reason why Carl-Allan Moberg, whose essay *Musik und Musikwissenschaft an den schwedischen Universitäten* (1929) is still the most important on this subject,¹⁶ did not hesitate to date the birth of music as an academic subject in Sweden back to 1477. This was the year that Uppsala University was founded, and there, just as in its model universities on the continent, the *artes liberales* were naturally practised.¹⁷ With the reign of Gustavus Vasa (1523–1560) and the ecclesiastical reformation, however, this university was closed for a long time, and in reality it was not reopened until 1595. The basics of music theory during this period were taught in Swedish schools.

Later, in the statutes of the university of 1626, strongly influenced as they were by the Ramist ideas of Johan Skytte,¹⁸ stressing the importance of usefulness of learned studies, it was decided that the professors of mathematics should be three. The *Euclideanus* should concern himself with arithmetic and geometry; the *Archimedeus* should teach optics, music and mechanics, and he sometimes also functioned as the *inspector musices* at the university;¹⁹ and the *Ptolemaicus*, the chair of highest rank of the three (second was the *Euclideanus*), should take care of astronomy, geography, and architecture.²⁰ The teaching of music should be based on the textbooks written by Jean-Thomas Freig, one of Glarean's disciples, and be in accordance with the Ramist ideas.²¹ But neither the first *professor Archimedeus*, Martinus Olai Nycopensis, nor the second, Benedictus Hedraeus, seem to have lectured on music theory, other than, possibly, those aspects pertaining to the field of acoustics.²²

Between 1625 and 1630, however, Jonas Columbus as the first and only *professor poëseos et musices* in the history of the university, was concerned both with practical music at the university, and with lecturing on music theory. A preserved student note-book from 1635 reflects the contents of Colum-

¹⁶ Bengt Kyhlberg's *Musiken i Uppsala II* (unpublished manuscript stored at the Music and Theatre Library of Sweden in Stockholm) was meant to include a chapter on music theory at the university after 1660, but does not do so presently in its unfinished shape. For this section I have nevertheless profited much from the rich notes contained in his archive, which is kept in the same place.

¹⁷ Moberg 1929, pp. 54 f.

¹⁸ As regards the educational views of Skytte, see Ingemarsdotter 2011.

¹⁹ Kyhlberg 1977, pp. 3 f.

²⁰ Annerstedt 1877, p. 278. Cf. Lindroth 1975, II, pp. 468 f., and Rodhe 2002, vol. 1, p. 6. For an overview of the historical sources containing mathematical theories of music relevant at the time of Vallerius, see Wardhaugh 2008, pp. 5 ff.

²¹ Moberg 1970[1942], p. 17.

²² Kyhlberg 1974, p. 91. Cf. Moberg 1929, p. 62.

bus's teaching.²³ In 1630 he left Uppsala for a vicarage in Dalecarlia. Later in the same decade two students also held orations to the praise of music. In 1632 Petrus Johannis Schottenius performed his *Oratiuncula de encomiis musices*, and five years later Petrus Johannis Ungius held his *Encomium musicae*. Several circumstances in this period indicate a weakened position for music in university teaching, and this is confirmed by the revised statutes of 1645, in which music was no longer mentioned as a responsibility of the *professor Archimedeus*.²⁴ With the university statutes of 1655 the number of chairs in mathematics were then even reduced to two, and the *Archimedeus* withdrawn. While the duties of the *Ptolemaicus* were more or less the same as previously, the *Euclideus* should now also take care of optics and architecture, with some further subfields.²⁵

Thus in 1674 when Harald Vallerius defended his exercise dissertation on sound, questions pertaining to music theory had more or less been absent from the university for several decades. Against this background we should also understand the quotation from Olof Rudbeck at the very beginning of this work, while the elements of this subject were usually covered at lower schools and *gymnasia* in Sweden.²⁶ Admittedly musical practice in Uppsala had developed immensely through Rudbeck in the 1660s,²⁷ and Vallerius had himself held a now lost oration entitled *Harmonia, qualis sit et cuiusmodi quia* in front of the other holders of scholarships in 1670.²⁸ The publication by the professor in Turku (Åbo) Johannes Gezelius of an *Encyclopedia synoptica* (1671), which contained a chapter of ten pages on music, could possibly also have had some importance in Uppsala.²⁹ Nevertheless it was not until the dissertation on sound in 1674 that music theoretical matters were reintroduced into scholarly discourse in their own right. The importance of this dissertation for the later history of music theory in Uppsala was thus stressed by Moberg:

... mit diesen wurde nämlich eine musikwissenschaftliche Tätigkeit an der Universität zu Uppsala eingeleitet, die mit wenigen und kurzen Unterbrechungen mehr wie ein ganzes Jahrhundert dauern sollte, ja noch im 19. Jahrhundert durch einzelne akademische Schriften fortgesetzt worden ist.³⁰

²³ Norlind 1900, p. 191, and Kyhlberg 1977, p. 4. On the contents of the note-book, see Moberg 1929, pp. 63 f. and Fransén 1940, p. 63.

²⁴ Moberg 1929, pp. 64 f.

²⁵ Lindroth 1975, II, p. 469.

²⁶ Fransén 1940, pp. 61 ff.

²⁷ Kyhlberg 1977, pp. 6 ff., and Annerstedt, II:2, pp. 354 ff.

²⁸ A handwritten program to this occasion, undersigned by Samuel Skunck, is still extant at Uppsala University Library (U 45).

²⁹ Cf. Fransén 1940, p. 76, where the similarities between the basic ideas represented in Gezelius's *Encyclopedia* and Vallerius's dissertations are stressed.

³⁰ Moberg 1929, p. 67. Cf. Hülphers 1969[1773], p. 101.

What follows in print from his activity during the last decades of the 17th century is then the other two dissertations edited in this volume. In 1686 the specimen on the modes was published, which was obviously meant as a continuation of the first text, and in 1698 that on *tactus*. But there are also other dissertations that contain musical subjects. In 1693 Vallerius had been the praeses at a disputation with the title *De campanis et praecipuis eorum usus* ('on bells and their particular usages'), with Nicolaus Duvaerus as the respondent. This dissertation treats the history of bells, their origins and dissemination, their usage in religious and profane contexts, and their practical uses. Its third chapter deals with the form, material and size of bells. Soon after the turn of the century a dissertation entitled *De tarantula* (1702)³¹ was published, with Harald's own son Georg Vallerius as the respondent. In the latter, the entire third chapter (pp. 18 ff.) deals with the question of why music has such power to heal the bites of tarantula spiders, among other things from the perspectives of *tactus* and modes. In the *Disputatio philosophica parallelismum microcosmi et macrocosmi breviter delineans* ('philosophical disputation that shortly describes the parallelism between microcosm and macrocosm') from 1711, with Andreas Samuel Pijl as the respondent, there is a treatment of the correspondences between music and harmony on the one hand, and human beings on the other (pp. 39 f.).

With other praesides we also find a small number of dissertations from this time containing musical subjects. In the *Orchestra sive de saltationibus veterum dissertatio* ('orchestra or dissertation on the dances of the ancients') from 1685, defended under Johan Bilberg's presidency by Isaac Macke, dancing is defined and explained, with a focus on the ancient dances. The impact of music on living beings is proved by the fact that even animals dance with rhythm. Isaac Vossius is here referred to in particular (pp. 8 and 11). In the *Dissertatio gradualis de antiqua et medii aevi musica* ('dissertation for the degree on ancient and medieval music') from 1706, defended by Harald's son Georg Vallerius, whom we met in *De tarantula* above, under the presidency of Johan A. Bellman, we have a treatise that stands out from the others in this category in scope and extent. This is in fact a rather comprehensive summary of the relevant aspects of music of the time, covering a little more than 100 pages in octavo format, which acknowledges the ancient and medieval heritage of music. Accordingly it deals with the history of music, with sound, modes, *tactus*, and other fundamentals, followed by discussions of the different kinds of instruments, on the affect-stirring potency of music, and a comparison between ancient and contemporary music. The ideas of Isaac Vossius permeate these later sections. And twice, when dealing with the modes, the author refers to

³¹ The tarantula-spider allegedly reacted to rhythm and danced along with the music that it heard, and thus proved the influence of music on the affects. Music could also heal the diseases caused by its bites. See the commentary on thesis 83 of *De sono* below.

Vallerius's *De modis* for further reading. One year later, in 1707, Sveno Gestrinius defended, under the presidency of Daniel Lundius, the *Dissertatio gradualis de musica Hebraeorum antiqua* ('dissertation for the degree on the ancient music of the Hebrews'). This treats the origin of music, and how the affects are stirred by it. Thereafter follows a chapter on the inventors of music among the Hebrews, as well as an account of their instruments. In the *De poëseos natura dissertatio* ('dissertation on the nature of poetry') from 1709, defended by Olaus Sund under Fabian Törner, the power of rhythm on the affects is stressed in particular, again supported by the ideas of Isaac Vossius. There comparisons are made with music (pp. 24 ff.). From the period shortly after Vallerius's time, the *Exercitium academicum instrumenta musica leviter delineans* ('academic exercise that gives a light description of musical instruments') from 1717 deserves special mention, since it was defended by Olaus Bergrot under the presidency of Johannes Vallerius, another of Harald's sons and his closest successor. To this dissertation we shall return several times in the commentaries below.³²

Once Vallerius held the chair of mathematics, he lectured specifically on music theory as well.³³ We can be sure of this from extant archive-material that contains reports to the university chancellor about what the professors of the university had lectured on. In these reports, only a part of which have been preserved, we see that Vallerius as a professor lectured most of all on geometrical subjects, but that he also did so on music during the autumns of 1699, 1701 and 1706. The same reports tell us that he, while still being a *professor extraordinarius*, had held *exercitia musica* in the spring and autumn of 1689.³⁴ Knowing that the reports are far from complete, we can tentatively assume that he had done both at other times as well.

Besides the dissertations there are extant manuscripts that contain treatments of musical subjects which seem to be based on Harald Vallerius's teaching. A volume with notes by Gabriel Gyllengrip from his time in Uppsala contains two *compendia* on music: the first is an *Instructio perbrevis ac perspicua, promte ludendi juxta Bassum Generalem* ('a very short and clear instruction of playing correctly according to thorough bass'), the second is a *Manuductio Musicae vocalis brevissima* ('a very short handbook in vocal music').³⁵ From the appearance of the music primer *Compendium musicum* of Andreas Orostander in 1699 (second edition in 1702), which was intended for pupils at Swedish *gymnasia*, we know that Vallerius's ideas on music had also spread far beyond the university circles in Uppsala. In this manual

³² For an overview primarily of German music dissertations from the 17th and the beginning of the 18th century, see Braun 1994, pp. 9 f.

³³ Annerstedt II:2, p. 318; and Lindroth 1975, II, p. 487.

³⁴ *Kanslersämbetet för Uppsala Universitet*, National Archives of Sweden (F I:1, vols. 6, 8, 17, 20 and 27).

³⁵ Fransén 1940, pp. 81 ff.

Vallerius's dissertations are referred to several times, and in addition his own words of censorship are printed after the main text.³⁶

Questions pertaining to music theory may have been rather unknown among learned circles in Uppsala at the time when Vallerius started his activity, but internationally the discussion of such matters had hardly been unprogressive since the last time they were investigated at the university. In addition, as H. F. Cohen in particular has stressed, the role of music in the scientific revolution usually tends not to receive fair attention, remembering that such scholars as Kepler, Galileo, Bacon, Descartes, Gassendi, Mersenne, and later also, for instance, Wallis, Newton and Leibniz, all included music in their fields of interest. And the main ideas that characterize this movement, which Cohen summarizes under the headings *mathematization*, *experiment* and *mechanization*, were also the ones that to a great extent contributed to progress within music theory, for example by the theoretical analysis of musical instruments based on empirical experiments.³⁷ It is worth bearing in mind that the three most important authors constantly quoted and referred to in the dissertations had virtually all published their major works on music during the period when music theory was absent from university education in Uppsala. Marin Mersenne's *Harmonicorum libri XII* was printed in 1636. We know, however, that Vallerius must have used the extended edition of 1648. René Descartes's *Compendium musicae* was first printed in 1650, although written as early as 1618, and Athanasius Kircher's *Musurgia universalis* was printed in 1650.³⁸ The same holds true for many of the other authors quoted and referred to. The importance of Vallerius and his dissertations in the history of Swedish music theory thereby gains further weight. They introduced the most recent ideas in music theory into the scholarly

³⁶ For further information see Lundberg & Sjökvist 2010. We also know that Vallerius on Orostander's behalf borrowed copies of Kircher's *Musurgia* (1650) and Descartes's *Compendium musicae* (1650) from Uppsala University Library on 23 February 1699, presumably for the work with the compendium (Uppsala University Library, *Bibl. arkiv* G:1, cf. Kyhlberg, *Musiken i Uppsala II* [the Music and Theatre Library of Sweden]).

³⁷ Cohen 1984, pp. 7 ff. and 85. Cf. Palisca 1961; and Gouk 2002, p. 243: "Throughout Western history, the making of music and the making of scientific knowledge have always been intertwined. At certain junctures, however, music theory seems particularly valuable to mathematicians, philosophers and scientists, and the links between their conceptual universe and that of music are manifest and direct. The period between 1550 and 1700, known as the scientific revolution, was one such epoch." For a sketch of the musical science during the earlier part of the Renaissance, see Palisca 1985, pp. 226 ff.

³⁸ As regards the special importance of these three works in the history of music theory in the first half of the 17th century, i.e. "the initial period of the incorporation of the new notions of mathematization, mechanisation and experiment into the science of music", see Wardhaugh 2008, pp. 20 ff. Cf. Braun 1994, p. 11, on the works of Fludd, Kepler, Mersenne and Kircher: ... *die Musik erscheint nicht mehr als Teil eines Wissenschaftssystems, sondern umgekehrt. Wohl nie zuvor und danach ist die Musik so radikal an die Spitze des Denkens gerückt worden* ..., but also Braun 1994, pp. 302 ff., for a treatment of the development of German music theory during the 17th century.

discourse at a moment when for a long time there had been only very limited activity in the field.

As implied above, however, Vallerius's musical interest certainly did not come about in a vacuum. In Uppsala Olof Rudbeck's support had meant that practical university music could take major steps forward, and it became fertile ground in which a talented young man such as Vallerius could grow and improve. Thus the importance of these two men in the music history of Sweden was later stressed by Sven Yckenberg in his *De fatis musices in Svecia dissertatio* ('dissertation on the fate of music in Sweden') defended in Uppsala in 1798:

But of all who were renowned for their great merits towards music, Harald Vallerius and Olof Rudbeck the Elder, Upsalian professors, easily claim the first place for themselves, since they should rightfully be greeted as the establishers and restorers of music.³⁹

It is true, however, that Vallerius's musical training had started many years earlier, when he was a boy in Linköping. His biography thus sheds additional light on the background of our dissertations.

1.3 Harald Vallerius's Life and Career⁴⁰

Harald Vallerius was born on 25 December 1646 in Vallerstad in Östergötland, a province in the south-eastern part of Sweden, as the son of vicar Johan Vallerius and Christina Holm, having no fewer than eleven older brothers and sisters. In his youth he was educated at the fine school and *gymnasium* of Linköping in the same region, and he received musical training in its cathedral, where the musical standard was high at the time.

In 1666 Vallerius matriculated at Uppsala university, and after a short while he became the client of the Chancellor of the University and the Swedish Realm Magnus Gabriel de la Gardie, 'the greatest patron of learned

³⁹ *Omnium vero qui ingentibus erga Musicam meritis fuerunt insignes, principem locum facile sibi vindicant Haraldus Vallerius et Olaus Rudbeckius Senior, Professores Upsalienses, statores ac restauratores Musices merito salutandi* (Yckenberg [1798], p. 19).

⁴⁰ The most extensive treatment of Vallerius's life is to be found in Hansson 1967, pp. 45 ff. Others are, e.g., Wrangel 1893, pp. 14 ff.; Palm 1904, pp. 90 ff.; Moberg 1929, pp. 67 ff.; Norlind 1945, pp. 75 ff.; *Svenska män och kvinnor*, vol. VIII; and Göransson 1992, pp. 41 ff., most of them containing references to further reading. The account here is in the first place a summary of these relations. However, biographical information can also be found in the funeral oration held on Vallerius by Johan Upmarck in 1716, printed in *Memoria virorum in Suecia eruditissimorum rediviva* ... (1729), pp. 101–150, a material seemingly not taken into consideration by Hansson, who only refers to Upmarck's *Lefvernes-Beskrifning* from 1777. Much source material on Vallerius was collected by Bengt Kyhlberg for the unpublished *Musiken i Uppsala II*, which can be found at the Music and Theatre Library of Sweden in Stockholm.

society', as Upmarck puts it in the funeral oration on Vallerius, and he was granted free meals in the community.⁴¹ He was later to come into close contact with the well-known Swedish polymath Olof Rudbeck, whose attention to Vallerius was caused by the latter's great musical skill. Later Rudbeck also pleaded Vallerius's cause in front of the authorities at several occasions.⁴² Vallerius was thus appointed *rector cantus* and organist at the cathedral of Uppsala in 1675, marrying Elisabeth Holtz, the widow of the previous *rector cantus*, organist and assistant librarian Carolus Petri Wallinus in 1676. At the same time he was appointed assistant librarian at the University Library,⁴³ and somewhat later even second librarian. He defended the exercise dissertation *De sono* in 1674, and a dissertation *pro gradu* with the title *De vacuo* in 1678, under the presidency of Matthias Steuchius. The main text of the latter, which is in fact a much more simple work than *De sono*, only embraces 22 pages in quarto format, and contains criticism of the ideas on vacuum that had been presented by Pierre Gassendi, among other things. The master's degree was conferred on Vallerius in 1679, and he was then counted as *primus* at the solemn promotion ceremony. The same year he also started to teach at the university. In 1684 he was appointed *professor extraordinarius* in physics on the recommendation of Olof Rudbeck to Magnus Gabriel De la Gardie, and in 1690 *professor ordinarius* of mathematics, succeeding the argumentative Cartesian scholar Johan Bilberg in this chair.⁴⁴

In the following period Vallerius was to become *rector* of Uppsala University at three different times (*rectores* were appointed for six months at a time), viz. 1696–97, 1702–03 and 1709–10,⁴⁵ and dean of the philosophical faculty on several occasions. Likewise Vallerius's abilities as a teacher were wide-ranging and highly esteemed.⁴⁶ Being professor of mathematics, he also lectured in physics, philosophy and music, and no fewer than 105 dissertations were defended under his presidency.⁴⁷ To a great extent they treat subjects within the fields of mathematics, physics and physical geography. In the dissertation *De matheseos incrementis* (1694), where

⁴¹ *Adscitus est ... in hanc societatem atque in clientelam maximorum, quotquot tum erant, patronorum literariae civitatis. Publici convictus gratuitam novo hospiti mensam adsignabat ... Magnus Gabriel de la Gardius* (Upmarck 1716, p. 120).

⁴² See e.g. *Uppsala Universitet. Akademiska konsistoriets protokoll*, vol. IX, p. 72.

⁴³ From an extant letter from Vallerius to Magnus Gabriel De la Gardie we know that both Johannes Loccenius and Olof Rudbeck had wanted Vallerius to be appointed to both positions, just as his predecessor. In the meantime, however, a certain Olaus Nezelius had been appointed assistant librarian. Vallerius thus addresses De la Gardie and suggests that the old custom should be observed. Obviously his application was approved (*Letter from Vallerius to Magnus Gabriel De la Gardie*, undated, National Archives of Sweden, Magnus Gabriel De la Gardies samling, volume E 1591).

⁴⁴ Rodhe 2002, p. 16.

⁴⁵ Nevéus 2011, p. 42.

⁴⁶ Cf. Lindroth 1975, p. 487; and Annerstedt II:2, p. 319.

⁴⁷ Lidén 1778, pp. 499 ff.

Vallerius asserts the superiority of the new mathematics over the ancient, he is seemingly the first in Sweden to quote Isaac Newton.⁴⁸

Vallerius held the professorship until 1712, when he retired because of poor health, and was succeeded in the chair by his son Johannes. Poor health had vexed Harald on many previous occasions. In his last years he even suffered from a disease in his eyes that made him blind in one eye, a fact that is clearly visible on the portrait of him still extant in the Uppsala University main building. He died in Uppsala on 8 March 1716 at the age of 70.

In the field of music Vallerius's contributions were many, and some are mentioned above. What we see there is that he was both a music theorist, and a skilful musician himself, the latter in contrast to most other authors of music theory of the time.⁴⁹ He played many instruments, and often performed at local concerts, and at several times also in front of the royal family in Stockholm and in Uppsala, sometimes together with other members of his family.⁵⁰ By virtue of his duties as *rector cantus*⁵¹ at Uppsala University, Vallerius participated in virtually all the important musical events that took place in the town. He also served as an organist in Uppsala cathedral, and it is even said that he arranged musical gatherings in his own home twice a week.⁵² Compositions by his own hand were used at some of these occasions, but there are no preserved compositions that can be attributed to him with certainty, despite some previous attempts to do so. According to a note by Rudbeck, Vallerius had composed music to the text *Gud give vår konung* ('May God give our King'), which was performed at the coronation of Charles XI in 1675.⁵³ Vallerius's by far most important and long-lasting contribution was, however, that he together with Olof Rudbeck edited the music for the first Swedish Book of Hymns (*Koralboken*) in 1697.⁵⁴

For Harald Vallerius musical practice was thus the natural way into deeper investigations into its theory, although admittedly his profession as professor of mathematics could traditionally embrace this subject as well. The same applies to the two students that acted as respondents in the

⁴⁸ Rodhe 2002, pp. 16 f.

⁴⁹ Cf. Gouk 1999, p. 22.

⁵⁰ E.g. Norlind 1945, p. 34.

⁵¹ According to Bengt Kyhlberg, however, Vallerius was never entitled *director musices*. Kyhlberg claims that the first person to be given that title was his successor Christian Zeller in the 1690s (Kyhlberg 1977, p. 9). But Vallerius in fact calls Olof Rudbeck *musices director* in his letter to Magnus Gabriel De la Gardie shortly after the death of Carolus Petri Vallinus in 1675, so the title was obviously used earlier than Kyhlberg claims (*Letter to Magnus Gabriel De la Gardie*, undated, National Archives of Sweden, Magnus Gabriel De la Gardies samling, volume E 1591).

⁵² *Cur tacebo illud, bis quavis hebdomade domum illius patuisse quibuslibet musices cultoribus?* (Upmarck 1729, p. 124). Cf. Moberg 1970[1942], p. 158.

⁵³ The same information is given by Upmarck in his funeral oration (1729, p. 124).

⁵⁴ On which see especially Hansson 1967 and Göransson 1992, both of which are doctoral theses which deal exclusively with this hymnal.

dissertations *De modis* and *De tactu*. Both were granted musical scholarships for practical participation in university music, and can arguably be supposed to have possessed more than only basic knowledge of music theory. The question could therefore arise as to who actually wrote the dissertations that were defended, and whether such a discussion is fruitful, considering what was said on authorship in the section on disputations and dissertations above.

1.4 The Question of Authorship⁵⁵

When dissertations from academies in the early modern period are discussed, there is an ever-lasting problem of authorship.⁵⁶ Who of the praesides and the respondents actually wrote the text of the dissertations? As has been stated so many times in previous research, a generally valid answer cannot be presented. It could be the praeses, the respondent, both of them, or neither of them. What can be said, however, is that the name of the true author, so to speak, or rather of *the person who held the pencil*, has little relevance in this kind of material. In general the intellectual content of the dissertations is more often more representative of the praeses' scholarly views than of the respondent's.⁵⁷ Nonetheless exceptions occur, as it does in our case with *De sono*, not least since a student had the right to approach any professor and request *praesidium*. However, the question of authorship appears whenever a new dissertation is discussed, and neither can it be avoided here, although anachronistic and misleading conclusions must not be drawn.⁵⁸

In our case Harald Vallerius is the obvious connection between the three dissertations. It is certainly understandable that he has generally been regarded as the author of all three dissertations,⁵⁹ considering his position in the musical life of late 17th century Uppsala. Nonetheless the picture should

⁵⁵ On the authorial question in early modern dissertations, which was from early on a matter of discussion especially for librarians trying to catalogue this kind of material, see Wheatley 1889, pp. 105 ff.; Horn, 1893, pp. 51 f.; Kaufmann 1894, pp. 222 ff.; Eichler 1896 and 1898; as well as Marti 2007. Cf. Annerstedt II:2, pp. 124 ff.; and III:2, pp. 169 ff.; Lindroth 1975, II, p. 32, and III, p. 32; Lindberg 1984, p. 46; 1990, pp. 168 ff. (with further references on p. 212), and 2006, pp. 120 f., but also Clark 2006, pp. 204 ff.

⁵⁶ Cf. Gindhart & Kundert 2010, pp. 17: *Auch wenn Respondent und Präses sowohl im Aufführungsakt als auch in der Disputationsschrift als eine Partei erschienen, bleiben sowohl ihre wissenschaftlichen Meinungen als auch ihr jeweiliger Arbeitsbeitrag zur Disputation oft unklar. Die Autorschaftsfrage ist dabei eines der schwierigsten Probleme der Disputationsforschung.*

⁵⁷ For this reason dissertations mentioned in this study are also entered under the praeses' second name in the bibliography below.

⁵⁸ Cf. Eichler 1898, p. 34: *Wenn uns also heute Disputationen vorliegen, über deren Verfässherschaft wir urteilen sollen, so müssen wir uns erst vergegenwärtigen, ob wir auch berechtigt sind, im heutigen Sinne nach der Autorschaft zu fragen. Wir sind es eben in den meisten Fällen zum Teil bis ins 19. Jahrhundert nicht.*

⁵⁹ E.g. Gerber 1966[1813], vol. 3, col. 839 and vol. 4, col. 498; Wrangel 1893, p. 17; Moberg 1929, pp. 69 f.; Fransén 1940, p. 76; Eitner 1959, p. 194; and Göransson, 1992, p. 47.

probably be somewhat revised. Karl-Johan Hansson has already raised suspicions, and has called for a deeper investigation into the authorship of *De tactu*.⁶⁰ Hansson certainly has a point, since, I claim, it is most likely that Vallerius wrote the two first dissertations, *De sono* and *De modis*, but in the third, *De Tactu*, there are strong reasons to believe that the respondent Olaus Retzelius held the pencil.⁶¹ The presence of a different authorial voice is perhaps the strongest argument, but there are several more circumstances that support the claim.

To begin with, the numbers of the theses in the dissertations, which in *De sono* end with no. 83, continue in *De modis*, which begins with thesis 84. The same holds true for the sheet signatures, which in *De sono* end on F and begin on G in *De modis*, both of which are in quarto format, despite the fact that there were two different printers and that there was an interval of twelve years between the times of publication. The indication in the title of the latter, that this was the *Disputatio physico-musica secunda*, says the same thing. These two are actually seen as two parts of one work.⁶² While Harald Vallerius was the respondent in *De sono*, where Andreas Norcopensis was the praeses, Vallerius was the praeses in *De modis*, where Nathanael Rydelius was the respondent. Evidently Vallerius is the common denominator between the two, but words on the title-page tell us even more. In *De sono* Vallerius himself shall subject the dissertation to public examination (*publico examini subjiciet*) under the presidency of Andreas Norcopensis (*sub praesidio ... Andreae Norcopensis*), in *De modis* Vallerius likewise himself subjects the dissertation to public examination (*publico examini subjicit*), but with Nathanael Rydelius as the respondent (*respondente Nathanaele Rydelio*). In spite of earlier warnings against letting close readings of title-pages have too much influence upon the decision in the authorial question,⁶³ we cannot help but understand this as an indication that Vallerius had written both dissertations himself. *He* subjects both dissertations to examination, once as the respondent, once as the praeses, and above all: the reading of them confirms this hypothesis. In both we also meet the same voice and the same language, with its characteristically clear style.⁶⁴

⁶⁰ Hansson 1967, p. 57.

⁶¹ Göransson (1992, p. 47) explicitly rejects the idea of Retzelius as the author, because of his later career as a jurist, not being a professional musician. The argument is irrelevant, though. There are many dissertations written by people in subjects far from their later professions. Retzelius's musical skill can in fact also be attested in the scholarship that he received in 1696 (cf. the biographical comments on him in *De tactu* below).

⁶² Cf. the records in Lidén 1778, pp. 359 and 499, as well as Annerstedt, II:2, pp. 325 and 355 f. In Annerstedt II:2, pp. 125 f. arguments similar to those presented here are used for the authorship of the two parts of *In leges Charondae* (1666–1667), with Brunnerus as the praeses.

⁶³ E.g. Horn 1893, pp. 82 f. Cf. Wheatley 1889, pp. 120 f., where the importance of the information on the title-page in this regard has clearly been exaggerated.

⁶⁴ Cf. Eichler 1896, p. 25, where stylistic differences in the texts of the dissertations are stressed as useful signs of different authors.

Moreover, Wrangel has also seen an expression in Andreas Norcopensis's congratulatory address in *De sono* as indicative in the authorial question concerning that dissertation. The words *juvenem de sono perite philosophantem* ('the young man philosophizing skilfully on sound') would point towards Vallerius himself as the author, in spite of the fact that he was only the respondent.⁶⁵ The possibility for a student to request the *praesidium* of any professor, as mentioned above, could explain why the professor of rhetorics Andreas Norcopensis is the praeses on a physico-musical subject such as that of sound, but it should also indicate a greater effort on Vallerius's behalf. Likewise it was very common that the praeses and the respondent, regardless of the subject defended, belonged to the same student nation, which they did if they came from the same region in Sweden. All three dissertations here fit into that pattern. Harald Vallerius, Andreas Norcopensis, Nathanael Rydelius and Olaus Retzelius all came from Östergötland, and were members of this student nation.

In the case of the *De modis*-dissertation, the circumstances that could support a claim that the respondent Nathanael Rydelius could have written the dissertation himself are rather vague. His words in the printed dedication to Johann Marker, for instance, which in fact cannot be found in all extant copies of the dissertation, are *Conamina. qualiacunque. mea*. Rydelius dedicates 'his endeavours of whatever kind they are', and since the dedication is part of the dissertation, a reader could easily assume that the 'endeavours' refer to the printed text. But the vagueness in itself probably indicates that Rydelius cannot really claim responsibility for the content of the dissertation, although there are several examples of cases where respondents have done so without actually being author.⁶⁶ Most likely the 'endeavours' in reality either refer to Rydelius's academic activities in general, or even to the oral defence at the disputation.⁶⁷

In *De tactu*, however, things are arranged in a completely different way. On the title-page we read that Olaus Retzelius delivers the dissertation to public examination (*ad publicum examen ... defert*) under the presidency of Harald Vallerius (*sub praesidio ... Haraldii Wallerii*). There are no words such as *disputatio tertia*.⁶⁸ The numbers of the theses begin anew from 1, and the sheet signatures start with A in octavo format. The dissertation begins with a brief summary of the two earlier ones, and when the author refers to Vallerius's first dissertation *De sono*, we meet phrases such as: *si [is] in compendium missam hanc doctrinam malit, elegantissimam amplissimi Praesidis nostri de Sono disputationem consulat* ('if he prefers to see this theory in abbreviation, he should consult the very fine Disputation on sound

⁶⁵ Wrangel 1893, p. 17.

⁶⁶ See especially Eichler 1896, pp. 32 ff.

⁶⁷ Cf. Annerstedt II:2, p. 125.

⁶⁸ This is neither indicated in Lidén 1778, p. 502.

of our most renowned praeses').⁶⁹ Vallerius is thus referred to in the third person. The reader is clearly supposed to believe that Retzelius wrote the text himself, although that is admittedly sometimes also the case in other dissertations when the praeses has written the text, as mentioned above.

Last but not least, the language and the style in *De tactu* differ from the two earlier dissertations (this shall be further treated in section 1.5.3 below), and to some degree so does the level of erudition. The first two dissertations, and the *De sono*-dissertation in particular, are to a greater degree based on empirical references and experiences, and they display a wider knowledge of the contemporary literature and research in the field. The dissertation *De tactu* is for a number of reasons to be considered as a somewhat more elementary piece, written by a younger and less skilled scholar.

On the whole, the dissertations *De sono* and *De modis* are thus to be understood as two parts of one work, whereas *De tactu* gives the impression of being a separate piece. It is very likely, though, that Vallerius had earlier planned to also treat *tactus* in forthcoming dissertations. In thesis 104 of *De modis* Vallerius explicitly says that he saves the question of *tactus* and its effects for another occasion. Likewise the last thesis of the same dissertation includes the words *ut in sequentibus patebit* ('as will be obvious in the following'), and this of course shows that his treatment of music theory was supposed to continue in some way.

In this study we will therefore follow the assumption that Harald Vallerius wrote the dissertations *De sono* and *De modis*, while the respondent Olaus Retzelius wrote the text of *De tactu*. Thereby can the notable discrepancies between the dissertations be suitably explained. But as was stated above, we should not exaggerate the importance of establishing the person who held the pencil in each specific dissertation. Without any doubt the content in all of them is representative of Vallerius's ideas on music theory.

When we now change focus, and continue by turning the attention more specifically towards aspects concerning the language and style of the dissertations, we shall leave this assumption hanging for a while. For at the end of that chapter we shall return to it, in order to add further supporting arguments. The language of the three texts, however, must all be considered to be representative of scientific neo-Latin of the time, although there are also obvious differences between them. The following chapter will therefore discuss what lies within this concept, as well as attempt to describe the characteristics of the language employed in the three dissertations.

⁶⁹ *De tactu* 1698, p. 4.

1.5 Language and Style

1.5.1 Language

It is a truism that neo-Latin authors aimed at writing in a language that they considered to be Classical. Equally true, however, is that the general impact of this circumstance tends to be exaggerated. This has not only been the case with earlier prominent Classics scholars as Eduard Norden, who explicitly claimed that the humanists killed the Latin language,⁷⁰ and medievalists as Dag Norberg,⁷¹ but sometimes even in our own time by distinguished researchers of neo-Latin. Edwin Rabbie, the editor of Hugo Grotius, in his authoritative and often cited article “Editing Neo-Latin Texts” from 1995 for instance still contends that:

Neo-Latin is an artificial language, meant as a revival of classical Latin, with a (very limited) incorporation of various later elements. This circumstance has resulted in the fact that no real development of the language during its long period of existence (ca. 1300 [in the Netherlands ca. 1500] –today) can be spoken of; vocabulary, morphology and syntax, and, as far as poetry is concerned, prosodic and metrical conventions, were on the whole fixed from the beginning. Perhaps only in the purely lexical field may we speak of a certain development (incorporation of post-classical words; neologisms), but this evolution has remained of a very limited character ...⁷²

But the idea of a general petrification of Latin after the Renaissance, as it is expressed in the quotation from Rabbie’s text, is undoubtedly false. As will be illustrated below, and as has already been stressed several times in previous research, long before Rabbie’s assertion, the Latin language hardly ceased to change and develop during the neo-Latin period, and least of all in scientific prose. Leonardo Olschki refuted Norden’s claim of the death of Latin after the Renaissance as early as 1922, with three main arguments: 1) The new Latin literature exceeded the vernacular in number in all countries of Europe during the 16th century, the result being that this century was the epoch when Latin was used most generally and consistently. 2) Latin was not only the language of the schools and the learned, but even entered into the family sphere. All children (i.e. boys) of good families had to learn Latin, illustrious examples being Michel de Montaigne and Henri Estienne. 3) Most

⁷⁰ *Der lateinschen Sprache, die im Mittelalter nie ganz aufgehört hatte zu leben und demgemäss Veränderungen aller Art unterworfen gewesen war, wurde von denselben Männern, die sich einbildeten sie zu einer internationalen Kultursprache zu machen, der Todesstoss gegeben* (Norden 1909, p. 767).

⁷¹ *Après la Renaissance, le latin a cessé de se développer et son histoire ne présente plus d'intérêt d'un point de vue linguistique. Il est devenu ce qu'on appelle souvent une langue morte* (Norberg 1968, p. 91).

⁷² Rabbie 1995, p. 27.

important, however, is the fact that the Latin language still continued to change:

Allerdings als bloße Kunstsprache, als bloße Rhetorik hatte das Latein zu leben aufgehört ... Künstlich war das Latein der Humanisten, lebendig das Latein der Forscher und Denker, die etwas Eigenes zu sagen hatten. Diese setzen in ihrem Lateingebrauch die mittelalterliche Überlieferung fort, erweitern die Sendung, erhöhen die Bedeutung und veredeln die Formen der alten Gelehrtensprache.⁷³

In the learned world the Renaissance did not cause a clear break with the medieval Latin tradition, but this took place only gradually and after several centuries.⁷⁴ In accordance with Olschki's statement, the reader of neo-Latin, and of learned neo-Latin in particular, usually cannot but notice that the incorporation of later elements in the language is in fact considerable. We meet many deviations from Classical standards in orthography, morphology, syntax as well as in vocabulary. Most of all, however, this holds true for the lexical field, where the development (incorporation of post-Classical words; neologisms) is by no means as limited as Rabbie claimed.

The statement in the very first sentence of this section must thus be nuanced, for a number of reasons. When discussing Classical purism in neo-Latin texts, some aspects are of crucial importance. The same authors have not always been considered as models. The degree of purism varies not only between different periods in time, and, most importantly, between different genres. It obviously often differed even between individual authors and scholars. And mostly the heritage from medieval Latin was inevitable. For a context very similar to ours, Emin Tengström summarized the situation as follows:

... the writer of learned Latin in the 17th century lived in a field of tension between two poles, on the one hand the living tradition with features of medieval Latin, and on the other the ideal of *imitatio* of *auctores probati*. The "classicism" of the day was therefore rather tolerant, except the ciceronianism, which did not play any role for learned Latin.⁷⁵

To begin with, the model ancient authors (*auctores probati*) were often different from those familiar to us from school and university teaching in our time. Both Plautus and Terence, for instance, were often regarded as worth following.⁷⁶ For authors writing on theological subjects, the Church fathers

⁷³ Olschki 1922, p. 68. Cf. Benner & Tengström 1977, pp. 5 ff.; Tengström 1983, p. 62; Waquet 2001, pp. 88 ff.; Helander 2001, p. 34, and 2004, p. 68.

⁷⁴ Waquet, for instance, accordingly asserts that a death of Latin cannot be spoken of until the eighteenth century (Waquet 2001, p. 272). In Sweden this happened even later.

⁷⁵ Benner & Tengström 1977, p. 8. Cf. Olschki 1922, pp. 70 f.

⁷⁶ See e.g. Noltenius, cols. 1833 ff.

were also numbered among this group.⁷⁷ Important neo-Latin authorities such as Cellarius sometimes even accepted words from medieval Latin, especially when they referred to new concepts and technical innovations.⁷⁸ A similar stance was taken by the French friar and scientist Marin Mersenne in *La verité des sciences* (1625). There he approved of neologisms invented by artisans and scientists, although they might seem barbarous, as far as they expressed in a better or briefer way what they wanted to say. *[N]ous sçavons aussi bien qu'eus [the Ciceroniani] que ces manières de parler ne sont pas cicéroniennes*, he wrote, and thereby disapproved of the complaints of linguistic purists.⁷⁹ At other times not even all of Cicero's own writings were accepted. And for Justus Lipsius, for instance, the main models were Seneca and Tacitus, not Cicero.⁸⁰

Related to this fact is the definition of Classical Latin itself. While we in this study understand it as the Latin that was written and spoken between Cicero and c. 120 A.D., we are all familiar with the division of the Latin language into ages: golden, silver, copper and iron, implying a gradual decay in linguistic purity. The definitions of these respective ages could vary according to different scholars, as could the degree to which imitation was allowed of authors from the different ages. Usually an author quite simply was good, regardless of when he had lived. The words *classicus* and *probatas* are then to be understood synonyms.⁸¹

Next comes the question of genre. Purism was always strived for more in literary texts than in scientific and learned ones. But nevertheless, while we often find words and grammatical features impossible to attest in ancient Latin even in the former category, in the latter authors were allowed and generally did not even hesitate to use unclassical words or to invent new ones if they needed to. Usage was characterized by eclecticism and pragmatism.⁸² At the same time we can often discern a clear desire here for, if not Classical authority, then at least a Classical sound. Besides *neologisms of form* and *loan-words* from other languages, we frequently meet *neologisms of sense* and *multiword terms*.⁸³

Finally, we will always find elements in neo-Latin texts that must be labelled as medievalisms. Partly this depends, of course, on the historical development itself. There were areas where the use of unclassical words was necessary, e.g. for social and political concepts, for academic and ecclesiastical ones, and, not least, for new inventions within the sciences and

⁷⁷ Tengström 1983, p. 63.

⁷⁸ Tengström 1983, p. 84.

⁷⁹ Mersenne 1625, p. 75, cf. Dear 1988, p. 17.

⁸⁰ Helander 2001, p. 32, and 2004, p. 67.

⁸¹ Cf. Benner & Tengström 1977, pp. 42 ff. and 62, Tengström 1983, pp. 83 ff. and Helander 2004, pp. 66 f.

⁸² Cf. Olschki 1922, pp. 76 ff.; Benner & Tengström 1977, pp. 61 ff.; Tengström 1983, p. 64; IJsewijn & Sacré 1998, p. 379; Helander 2001, pp. 32 ff., and 2004, pp. 65 f.

⁸³ For definitions of these terms, see the section on vocabulary below.

the arts.⁸⁴ Attempts to avoid such words were often doomed to failure, and sometimes even ridiculous, as when the *Ciceroniani* wanted to introduce pagan designations for elements of the Christian liturgy.⁸⁵ But medieval Latin certainly did not only affect vocabulary. We meet obvious reminiscences of it in orthography, morphology and syntax as well.

In the following attempt to describe the language of the three dissertations under investigation, the reader should constantly have these general facts in mind. Different model authors, the differing concepts of Classical Latin, genres, and medieval Latin, or rather ‘all previous history of Latin’, are all factors that make the language deviate from what we today consider as Classical. As we shall also see, taken together, the dissertations contain a great number of such divergences from what could be labelled as ‘Classically correct’. Nonetheless they are all, but *De sono* and *De modis* in particular, I claim, distinguished by a clear and efficient language.

There are, however, some natural implications connected with using Classical Latin (as we define it here) as the measure according to which we estimate the language of the dissertations. One is precisely this: we are using *our* definition of Classical Latin, as an analytical tool. As we have seen, for neo-Latin authors this definition was not particularly relevant. Another is, of course, that we would not usually expect to meet such Classical features present in the dissertations in the accounts below, but rather their deviations. Another is that the scientific and musical *termini technici* that were already used in Classical Latin are also generally absent. But in authors that were allegedly using ‘an artificial language, meant as a revival of classical Latin’, the unexpected naturally deserves most interest.

In the discussions below, the reader should also remember the suggestion made in the previous section on authorship. There it was assumed that Harald Vallerius was the author of *De sono* and *De modis*, while Olaus Retzelius was holding the pencil in *De tactu*. We thus have to consider two different authorial voices. The differences in language and style that are discernible below, between the two first dissertations and the third, will serve as further arguments to support both the assumption of two different authors, and the idea of individual differences in linguistic purism.

Orthography

It was mentioned above that neo-Latin orthography contains evident reminiscences from medieval Latin – initially neo-Latin orthography was in fact medieval – and there is nothing new in that. Such spelling was then usually also considered as correct and in accordance with the authoritative etymological theories of the time. With time, however, knowledge of the

⁸⁴ Cf. IJsewijn & Sacré 1998, pp. 386 ff., Tengström 1983, p. 63; Helander 2001, p. 35 f. and 2004, pp. 67 f.

⁸⁵ Cf. Olschki 1922, p. 71; and IJsewijn & Sacré 1998, p. 382.

correct orthographical variants grew among lexicographers, a fact that is often illustrated below in the comparisons between the dictionaries of Jonas Petri Gothus (JPG) from 1640, Basilius Faber Soranus (BFS) from 1686, and Noltenius from 1744. But in reality most authors still continued to use the old erroneous versions for a long time. Spelling was learnt by imitation, and practice changed slowly.⁸⁶

Accordingly, our three dissertations naturally display most of the usual orthographical features characteristic of Latin texts from the early modern period. These features have been accounted for, treated and repeated in a great number of previous neo-Latin studies.⁸⁷ We shall here thus only briefly mention some examples of the most common deviations from the Classical standards that have been established in contemporary handbooks such as *Thesaurus Linguae Latinae* (TLL) and *Oxford Latin Dictionary* (OLD), together with some examples from the present dissertations. This is primarily done for the convenience of those readers who are not accustomed to reading early modern Latin texts where the original orthography is retained. But the reader's attention is also drawn to some few but flagrant differences in orthographical practice between *De sono* and *De modis* on the one hand, and *De tactu* on the other.

The spelling of *oe*, *ae* and *e* is often confused:

- *caeteris* for *ceteris* (*De sono*, X). The former spelling is used in *De sono* and *De modis*, the latter in *De tactu*. Both JPG (s.v. *caetera*) and BFS (s.v. *caetera*) have *ae*. Noltenius (col. 37) says that *ceteri* is more correct than *caeteri*.
- *moestum* for *maestum* (*De modis*, CVII). Both JPG and BFS (s.v. *moer-eo*) have *moestus*. Noltenius (col. 110) prefers *maestus*.
- *poenituerit* for *paenituerit* (*De tactu* XVI, *De modis* CVII). Both JPG and BFS have *poenitet*. Noltenius (col. 139) prefers *poenitet*, because of the alleged relation of *poena* with ποινή, but he tolerates *paenitet*.

There is often a confusion of *ti* and *ci* before vowels. In our texts this appears especially in words containing *nuntiare*. For this word both JPG and BFS allow both spellings, but while JPG (s.v. *nuntio*) prefers *nuntiare*, BFS (s.v. *nuntius*) prefers *nunciare*. Noltenius (col. 125) accepts both spellings. In the texts we meet:

- *pronunciare* for *pronuntiare* (*De sono*, LIV).
- *pronunciatio* for *pronuntiatio* (*De tactu*, VII).
- *enunciet* for *enuntiet* (*De tactu*, VIII).

⁸⁶ Benner & Tengström 1977, p. 70; Helander 1995, pp. 20 ff., and 2001, pp. 27 ff.

⁸⁷ See e.g. Benner & Tengström 1977, pp. 69 ff.; Tengström 1983, pp. 66 ff.; Helander 1995, pp. 20 ff.; IJsewijn & Sacré 1998, pp. 472 f.; Östlund 2000, pp. 31 ff.; Helander 2001, pp. 27 ff.; Sjökvist 2007, pp. 69 ff.; and Eskhult 2007, pp. 142 ff.

There is often a confusion of *i* and *y*:

- *hyeme* for *hieme* (*De sono*, VI). JPG has *hyems*. BFS (s.v. *hyems*) allows both spellings.
- *lachrymosum* for *lacrimosum* (*De modis*, XCVIII). JPG (s.v. *lachryma*) allows both *lachryma* and *lacryma*. BFS has *lacryma*. Noltenius (col. 89) prefers *lacrima*, although states that *lachrima* also has ancient authority.

There is sometimes an aspiration of consonants:

- *lachrymosum* for *lacrimosum* (*De modis*, XCVIII). See above.

There is sometimes a confusion in the use of *p* between *m* and *s* or *t*. We meet:

- *desumsisse* for *desumpsisse* (*De modis*, XCIX).
- *desumta* for *desumpta* (*De tactu*, V).
- *sumto* for *sumpto* (*De tactu*, VII).

In JPG we find *sumptus*, but some other forms without *p*, as the future participle *sumturus*. In BFS (s.v. *sumo*) forms with and without *p* alternate. Noltenius (col. 174) prefers the spelling without *p*, but states that both variants have ancient authority.

There is a confusion in the usage of *n* and *m* before *qu* in the texts:

- *unquam* for *umquam* (*De sono*, XXXI). Both JPG and BFS have *unquam*. Noltenius (col. 192) prefers *umquam*.
- *tanquam* for *tamquam* (*De modis*, XXCIX). Both JPG and BFS have *tanquam*. Noltenius (col. 178) prefers *tamquam*.
- *quancunque* for *quamcumque* (*De tactu*, VII). Both JPG and BFS (s.v. *qui*) have *quicunque*. Noltenius (col. 149) says that *quicumque* is the correct variant.

But:

- *tamquam* (*De modis*, LXXXV). See above.
- *utrimque* (*De modis*, CXI). Both JPG and BFS (s.v. *uter*) has *utrinque*.
- *quacumque* (*De tactu*, VII).

There is often an inconsistent spelling of double and single consonants:

- *imo* for *immo* (the former spelling used in *De sono* and *De modis*; the latter in *De tactu*). JPG has both, but directs the reader from *immo* to *imo*. BFS (s.v. *immo*) allows both. Noltenius (col. 81) accepts both, but prefers *immo*.
- *quatuor* for *quattuor* (*De modis*, XXCIX; *De tactu*, X). While JPG allows both, BFS only has *quatuor*. Noltenius (col. 147) claims that *quattuor* is correct.

- *litararum* for *litterarum* (*De sono*, ded.). Both JPG and BFS have *lita*. Noltenius (col. 92) says *littera* is correct.

Other common deviant spellings are, for example:

- *quum* for the conjunction *cum* (eight times in *De sono*, six times in *De modis*, not used in *De tactu*), used in order to distinguish it from the preposition. JPG has *Quum vel cum, vel quom. Ita scribebant veteres quando adv. temporis erat*. BFS (s.v. *quum, adverbium temporis*) directs the reader to *cum*. Noltenius (col. 46) says *quum* should be used for the conjunction.
- *heic* for the adverb *hic* (the latter used in *De sono* and *De modis*, the former used in *De tactu*), used in order to distinguish it from the pronoun. Both JPG and BFS have *hic*. Noltenius (col. 72) accepts both, and does not oppose those who want to use *heic* for the adverb (as regards both *quum* and *heic*, cf. Östlund 2000, pp. 31 f.).
- *arctius* for *artius* (*De sono*, VIII). Both JPG and BFS (s.v. *arceo*) have *arctus*. Noltenius (col. 24) accepts both variants.

Morphology

As could be expected, in morphological respects there are some, but not very many, deviations from the general classical practice in our dissertations, and the divergences that do occur are mostly also to be found in other neo-Latin authors. Features that are relatively rare in ancient Latin here often become much more common. Sketches of the morphology characteristic of neo-Latin texts are plentiful in previous research.⁸⁸ We shall thus also keep this section brief, focusing on the individual peculiarities of our texts.

- The extended usage of the fifth declension. In the dissertations occur examples such as *crassities* (*De sono*, XXXIII, *De tactu*, V) instead of the in ancient Latin much more common *crassitudo* (both JPG and BFS have both. Noltenius [col. 490] states that *crassitudo* is much more common in ancient authors). While in ancient Latin it is almost only *res* and *dies* that occur in the plural genitive and dative or ablative of this declension, here we also find *species* in such forms, e.g. *De sono*, LXVIII; *De modis* CXII; *De tactu* XI (cf. Helander 2001, pp. 31 f.).
- The ablative singular of adjectives with the comparative ending in *-i* instead of the Classical *-e*, a usage that had been established in medieval Latin. We find for example:
 - *priori* (*De sono*, XXX).
 - *vehementiori* (*De sono*, XXXVII).

⁸⁸ See e.g. Benner & Tengström 1977, pp. 72 ff.; Helander 1995, pp. 22 ff.; IJsewijn & Sacré 1998, pp. 405 ff.; Östlund 2000, pp. 35 ff.; Helander 2001, pp. 29 ff.; Sjökvist 2007, pp. 71 f.; and Eskhult 2007, pp. 148 ff.

- *posteriori* (*De modis*, LXXXVII).
- *recentiori* (*De tactu*, VIII).
- *celeriori* (*De tactu*, XI).

But on one occasion, in a quotation from Pierre Gassendi, we also meet *validiore* (*De sono*, LXV).

- *necessum* for *necesse*. The former occurs five times in *De sono*, twice in *De modis*, and twice in *De tactu*. The latter twice in *De sono*, and twice in *De tactu*. They were regarded as parallel forms and equal in sense at this time (Östlund 2000, p. 36; and Örneholm 2003, p. 19). Both JPG and BFS have both forms.
- The common use of the pronouns *hic*, *haec*, *hoc*, in their different inflected forms, with the deictic suffix *-ce* (see further Östlund 2000, pp. 35 f.). We meet for example:
 - *hisce* (four times in *De sono*, 15 times in *De modis*, six times in *De tactu*).
 - *hosce* (three times in *De modis*).
 - *hocce* (once in *De tactu*).
 - *hicce* (once in *De tactu*).
 - *hasce* (twice in *De tactu*).
 - *hujusce modi* (five times in *De tactu*).
- The addition of the strengthening *-met* to *ipse*. We find:
 - *ipse met* (*De sono*, ded., and XXVII).
 - *ipsa met* (*De sono*, XXI).
 - *ipsi met* (*De modis*, CXVI).

It does not occur at all in *De tactu*. This usage is much more common in neo-Latin than in ancient Latin (Helander 1985, p. 29).

- The typically neo-Latin form *seorsim* is used for *seorsum* (*De sono*, XXIII, LVIII; *De modis* XCI). While JPG has both, BFS only has *seorsum*. Noltenius (col. 159) claims that *seorsum* is correct.
- The Greek flection of Greek loan-words, which are numerous in our texts. We meet for example:
 - *ellipsin* (*De sono*, XLII).
 - *Musices* (*De modis*, CXVII).
 - *Pana* (*De tactu*, grat. 1).
- The Greek loan word *echo* is seemingly treated as indeclinable by Vallerius, and occurs in this very form *echo* in the dissertations as a plural nominative, as a singular genitive and as a singular ablative (see the commentary on *De sono*, LXV). In ancient Latin it is only attested in the singular nominative *echo* and the singular accusatives *echo* and *echon* (TLL, s.v. *echo*). Both JPG, BFS and Noltenius (col. 54) say that the genitive singular is *echus*.
- The nominative form *tonitru* in ancient Latin is only found in the grammarians (Forcellini, s.v. *tonitrus*, c). In neo-Latin it is often considered

as indeclinable in the singular (cf. JPG; see further the commentary on *De sono*, LXII).

- The Greek loan-word *chelys* we find in the singular genitive *chelis* (*De sono*, LXXXI) and the plural genitive *chelyum* (*De sono*, XXVI). In ancient Latin only the singular nominative, accusative, ablative and vocative forms can be found (see commentary on *De sono*, XXVI). JPG says the singular genitive is *chelis*.
- The Greek loan-word *catadupa* is in ancient Latin only attested as a plural neutrum. We meet it here as *catadupas*, viz. a feminine plural in the accusative (see the commentary on *De sono*, LXXXI). BFS likewise has *catadupa*, -ae.

Syntax

Also concerning the syntactical aspects in the language of the dissertations, we notice some obvious divergences from Classical practice, as we define it. For the most part, these are either typical of neo-Latin generally speaking, or more specifically of scholarly neo-Latin, mirroring a time when syntax received relatively scanty attention in grammars and manuals of Latin. Not until the 19th century was Classical syntax systematically studied. The lack of knowledge is especially visible in the use of mood in subordinate clauses (notably, however, the subjunctive in indirect questions is usually respected in our texts).⁸⁹ As with orthography and morphology, the general characteristics of the syntax in neo-Latin texts have been dealt with in many previous studies,⁹⁰ and the same holds true here as for the sections above. We shall briefly repeat some common deviations, but we shall also mention some that are especially striking in our texts. Further occasional divergences are dealt with in the commentary.

- The shifted perfect passive, i.e. a perfect participle with a form of *esse* in the perfect instead of the present tense, occurs at some instances (*De sono*, LXII; *De modis*, LXXXVI), but is far less common than in other scientific prose of the time (cf. Östlund 2000, pp. 42 f.). Admittedly it can also be found in ancient Latin, but it was not more widely used until late Latin (Kajanto 1979, pp. 57 ff.; cf. Sz., pp. 320 ff.).
- *Quod*-clauses where according to Classical standards we would expect the *accusativus cum infinitivo* to occur. We meet, for example:
 - *notandum est quod particulae aëris aliave corpora ... suo tamen motu nunquam nisi unam tantum simplicem lineam describant* (*De sono*, X).

⁸⁹ Benner & Tengström 1977, pp. 80 ff., and Tengström 1983, pp. 75 ff. Cf. Östlund 2000, pp. 44 ff.

⁹⁰ E.g. Benner & Tengström 1977, pp. 75 ff.; Helander 1995, pp. 24 ff.; IJsewijn & Sacré 1998, pp. 410 f.; Östlund 2000, pp. 38 ff.; Helander 2001, pp. 29 ff. and Eskhult 2007, pp. 153 ff.

- *Quod complexionum diversitas ... in hominibus valeat hanc perceptionum varietatem ... producere, facile concedimus* (*De modis*, CI).
- *Idque inde facile constat, quod ejusmodi numeri non inter se primi, sed compositi intelligantur* (*De tactu*, IX).

Such *quod*-clauses can be found both in the indicative and in the subjunctive (cf. Östlund 2000, pp. 39 f.).

- *Quod*-clauses, be they explanatory or causal, are sometimes in the subjunctive. This usage is mainly late Latin, while in Classical Latin such clauses were usually in the indicative. See for example:
 - *de captura piscis Psyphiae, quae ... perficitur hoc modo, quod certis verbis prolatis pisces ad cymbam conveniant* (*De sono*, LXXXIII).
 - *Quod autem tanta sit tam inter veteres quam modernos in hisce discrepantia, causam dicit Kircherus* (*De modis*, C).
 - *Id ... hoc certius nobis persuademus, quod etiam immanes saepe bestias cantu ita flexas ... non paucas invenire liceat* (*De tactu*, I).
- *Cum*-clauses with the indicative where Classical Latin would most often have the subjunctive, for example in *De sono*, LXXVIII (see the commentary).
- *Quia*-clauses with the subjunctive occur at a few instances (*De sono*, V; *De modis* LXXXIX), while the vast majority of these clauses have the ‘Classically correct’ indicative. In late Latin the use of the subjunctive in such clauses became more common (K.-St., II, pp. 384 f.).
- While in classical Latin names of months are adjectives, they are here treated as nouns, for example: *ad diem ... Novembris* (*De sono*, title), *ad diem ... Aprilis* (*De modis*, title), and *ad diem ... Decembris* (*De tactu*, title).
- Comparative forms of adjectives with *magis* occur at several instances, for example:
 - *materia magis porosa* (*De sono*, IX).
 - *spiritus magis crassos et languidos supponunt vel efficiunt* (*De modis*, CVI).
 - *Musicam magis diminutam reddentes* (*De tactu*, XI).

Such forms were rare in classical Latin, but became somewhat more frequent in late Latin, and very common in the Middle Ages (Tengström 1983, p. 72).

- There is a highly frequent, extended, and sometimes superfluous usage of the demonstrative pronouns *ille* (see e.g. *De sono*, XXII) and *ipse* (see e.g. *De sono*, XXX). Often they are used instead of *is*, *ea*, *id*. The feature is typical of late Latin (cf. Sz., pp. 179 ff.; and Löfstedt 1933, vol. II, pp. 46 ff.).

Vocabulary

In the categories above we have met a certain number of deviations from the Latin that we today define as Classical. In the description of the words used in the dissertations at hand this circumstance will be even more obvious, and this fact alone should call for a deeper focus on this area. While the general characteristics of neo-Latin orthography, morphology and syntax have also been outlined in several earlier studies, much attention must still be directed to questions pertaining to vocabulary in particular.⁹¹ This holds true not least in fields where neo-Latin studies have been carried out to a lesser extent, as in our case with the history of music theory.

For in the texts we meet a great number of words that are either very rare in Classical Latin, or impossible to attest at all in texts from that period, but which are nevertheless frequently used by neo-Latin authors. Sometimes these words would fit very well with Classical standards, if they only had been attested, since they were created in perfect analogy with other similar forms. Considering the large number of Latin texts that have been destroyed or lost through the centuries, it is also probable that several of such words may have actually existed, or at least *could* have existed, in antiquity.⁹² Erasmus in his satirical *Ciceronianus* touches upon several aspects of relevance when discussing this subject. Accordingly, Erasmus asks how you could be an absolute Ciceronian when you have not read the big portion of Cicero's works that have been destroyed? Moreover: where will you find the proper words, when you must treat matters that Cicero did not treat?

Qui potes igitur absolutus esse Ciceronianus, qui tam multa illius non legeris? Adde quod Cicero non tractavit omnes materias. Ergo si forte dicendum fuerit de his, quas ille non attigit, unde tandem petemus orationis suppellectilem?⁹³

The same holds true here. It is often necessary to deal with vocabulary of a more technical nature. In the field of music the most important ancient Latin authors are to be found in late antiquity (Boethius, Martianus Capella, etc.), the period during which the achievements of earlier Greek music theorists were made available in Latin on a larger scale. Music treated in Latin thus necessarily uses a vocabulary that must most often be labelled as late Latin. However, with progress in the field new words were coined, and old words came to be understood in a new way. We shall thus find a large number of words that are post-ancient, including the names of musical instruments. To

⁹¹ Cf. Helander 2001, p. 35: "The elucidation of the growth of Latin vocabulary in scientific and learned texts should be seen as one of the most important areas of Neo-Latin philology."

⁹² Cf. IJsewijn & Sacré 1998, p. 382; Helander 2001, pp. 33 ff., and 2004, pp. 65 f.

⁹³ Erasmus 1972, p. 66. Later on in the same work: *Quot milia sunt rerum, de quibus nobis frequenter dicendum est, de quibus M. Tullius ne somniavit quidem* ('how many things there are, about which we often have to talk, about which M. Tullius had not even dreamt'[p. 100]).

this category also belong the words in the texts which are rendered in the vernacular. Usually these are either Italian (**It**) or Swedish (**Sw**) technical music terms. While the former were often internationally well-established in music discourse at the time (although not always unambiguous in sense), and apparently did not require a Latin translation, the latter are most often employed within parentheses in the texts of the dissertations for explaining and specifying technical musical features that would otherwise sometimes only be understood with difficulty, since precise Latin equivalents were either missing or not known to the authors at all. Exceptions are the words referring to military signals. All vernacular terms shall be accounted for at the end of this vocabulary section.

Finally, we sometimes meet words that are specific to scientific discourse. These are often strongly indebted to the developments of philosophical terminology in the Middle Ages. But the great progress of scientific research in the 17th century, in which music had a much stronger position than is often generally acknowledged,⁹⁴ increased the number of neologisms as well. An especially striking phenomenon in this last category are the many neologisms created from Greek stems (e.g. *atmosphæra*, *chronometron*, *musarithmicus*, *polyplectrus*).⁹⁵

As Werner Braun has stated quite generally on music terminology of this time, Latin terms were used for the traditional mathematical and non-practice-based parts of music, as well as for the concepts taken over from rhetoric. Italian designations, which are sometimes Latinized, were used for features from the music theory of the 16th and 17th centuries referring to performance practice, e.g. instruments, genres, dynamics and time. The vernacular terms (German in Braun's account) had their origin in activities, professions and things.⁹⁶ As we shall see below, this also holds true as a general description for the vocabulary of our texts.

With this outline as a background, it is natural to divide the treatment below in three major groups, viz. *general vocabulary*,⁹⁷ *scientific vocabulary*, and *music vocabulary*. The boundaries between them are certainly not clear-cut. Some words could deservedly be placed under more than one heading. *Rare words (R)*, i.e. words that are rare in classical Latin, *neologisms of form (NF)*, i.e. phonetically novel coinages, *loan-words (LW)*, i.e. words borrowed from languages other than Latin, *neologisms of sense (NS)*, i.e. already existing words with new senses, and *multiword terms*

⁹⁴ Cf. e.g. Gouk 1999, pp. 19 f.

⁹⁵ Cf. Pitkäranta 1992, p. 8 f.; IJsewijn & Sacré 1998, pp. 388 f.; Helander 2001, p. 34, and 2004, pp. 69 ff.

⁹⁶ Braun 1994, pp. 16 f.

⁹⁷ The concept *general vocabulary* accords with the definition of Benner & Tengström, viz. "all words that do not directly express the systems of concepts belonging to the particular sciences and branches of learning" (Benner & Tengström 1977, p. 58.)

(MT), i.e. the combining of two or more existing words into a new term,⁹⁸ will be taken into consideration without discrimination, and the words will receive only one of these possible labels, although several of them could justly have more than one. Neither does the account pretend to be completely exhaustive. In music terminology, for instance, several terms and instruments are under constant development from the Middle Ages onwards. To establish the precise sense and its first occurrence in music history in such cases can hardly be done conclusively in a study of this kind. The classification made under the heading *music vocabulary* should for the same reason be considered as preliminary to a higher degree. Nonetheless the aim has been to treat as many rare classical and unclassical words as possible in this list, in the senses in which they occur in the dissertations, under the headings *Rare classical and late Latin*, *Medieval*, and *Neo-Latin*. In the division the Classical period is understood as Cicero – c. AD 120, the late Latin period as c. 120 – c. 600, the medieval period as c. 600 – c. 1500, and the Neo-Latin period as after c. 1500.⁹⁹

In the list, as well as in the commentary, we shall at several times also meet the verdicts on the words as they are expressed in the well-known *antibarbari* of Noltenius¹⁰⁰ and Krebs & Schmalz.¹⁰¹ It is true that these are not perfectly contemporary with our dissertations, but nevertheless they mirror very well the puristic zeal present among some neo-Latin authors and authorities at a somewhat later time.¹⁰² As we shall see, such considerations apparently held little import for the authors of our dissertations.

General vocabulary

Rare Classical and late Latin

- *aequivalenter* (NF) – ‘equivalently’ (*De modis*, CXVI). The verb *aequivaleo*, from which the adverb is created, is late Latin (Forcellini, L&S), but it was for a long time considered as Classical (cf. e.g. JPG). Noltenius (col. 409) and Krebs & Schmalz reject it.
- *allisio*, *-onis* (NF) – ‘a striking upon’ (*De tactu*, II). Cf. *TLL*, and Blaise [1].
- *antistes*, *-itis* (NS) – ‘bishop’ (*De tactu*, ded.). Cf. *TLL*, s.v. *antistes*, 185, 32 ff.; and Blaise [1], s.v. *antistes*, 3; but also JPG and BFS.
- *augmentum*, *-i* (R) – ‘increase’ (*De sono*, XXXIX). Cf. Blaise [1], and *TLL*. Both Noltenius (col. 431) and Krebs & Schmalz reject it.

⁹⁸ The definitions follow Benner & Tengström 1977, pp. 54 ff.

⁹⁹ The divisions follow Benner & Tengström 1977, pp. 30 and 41.

¹⁰⁰ *Ioh. Frid. Noltenii ... Lexicon Latinae lingvae antibarbarvm qvadrupartitvm ...* Leipzig and Helmstadt, 1744.

¹⁰¹ *Antibarbarus der lateinischen Sprache ...* von J. Ph. Krebs. 7. Aufl. in vollst. Umarbeitung ... von J.H. Schmalz, vols. 1–2. Basel 1905–1907.

¹⁰² Of these Krebs & Schmalz (first edited in the 1830s) in particular reflects a newer and more restrictive way of writing correct Latin (cf. Tengström 1983, p. 65).

- *binarius*, -a, -um (NF) – ‘binary’ (*De tactu*, VIII, XIV, XV). Cf. *TLL*; and Blaise [1].
- *campana*, -ae (NF) – ‘bell’ (*De sono*, XXVI, XXXIV, XL, LIV, LX, LXII; *De tactu*, XX). Cf. Blaise [1], *TLL*, and Krebs & Schmalz.
- *cavitas*, -atis (NF) – ‘cavity’ (*De sono*, XXIX, XXX, XXXV, LVII). Cf. Blaise [1], and *TLL*. It is rejected in Noltinius (col. 457) and Krebs & Schmalz.
- *chartaceus*, -a, -um (NF) – ‘of paper’ (*De tactu*, ded.). Cf. *TLL*, and Blaise [1]. Noltinius (col. 459) rejects it.
- *circularis*, -e (R) – ‘circular’ (*De sono*, VII, XII, XV, LXVI). Hapax in Classical literature in Balbus (beginning of 2nd century). Noltinius (col. 462) rejected it as medieval, Krebs & Schmalz as late Latin.
- *circumductus*, -us (R) – ‘circumference’ (*De sono*, XLII). Hapax in Classical literature in Quint. *inst.* 1.10.43.
- *circumferentia*, -ae (NF) – ‘circumference’ (*De sono*, XIV). Cf. *TLL*. Noltinius (col. 462) rejected it (see the commentary).
- *circumgyro*, 1 (NF) – ‘go around’ (*De sono*, VII, VIII). Cf. Blaise [1], and *TLL*.
- *circumquaque* (NF) – ‘all around’ (*De sono*, XII, XV, XXI, LXIX). Cf. Blaise [1], and *TLL*. It is rejected in Krebs & Schmalz (s.v. *circum*).
- *claviculus*, -i (NF) – ‘small stick’ (*De sono*, XL). Cf. Blaise [1], and *TLL*.
- *combinatio*, -onis (NF) – ‘combination’ (*De sono*, LXXXIII; *De modis*, LXXXIV, LXXXV, XCV, CII). Cf. Blaise [1], and *TLL*. Both Noltinius (col. 467) and Krebs & Schmalz reject it.
- *complexio*, -onis (NS) – ‘complexion’ (*De modis*, LXXXV, C, CI; *De tactu*, XVIII). Cf. Blaise [1], s.v. *complexio*, 5. Both Krebs & Schmalz and Noltinius (col. 474) reject it (see the commentary on *De modis*, LXXXV).
- *crassities*, -ei (NF) – ‘thickness’ (*De sono*, XXIX, XXXIII, XXXIV; *De tactu*, V). First attested in Apul. *met.* 7.5 (cf. Noltinius, col. 490). Rejected in Krebs & Schmalz.
- *diabolicus*, -a, -um (LW) – ‘devilish’, from the Greek διαβολικός (*De modis*, LXXXV). Cf. *TLL*, and Blaise [1].
- *dispensatio*, -onis (NS) – ‘God’s arrangement of the world’ (*De sono*, *grat.* 2). Cf. *TLL*, s.v. *dispensatio*, 1398, 66 ff.; and Blaise [1].
- *dispondeus*, -i (LW) – ‘a double spondee’, from the Greek δισπόνδειος (*De tactu*, X). Cf. Souter; and *TLL*.
- *diversimode* (NF) – ‘in different ways’ (*De modis*, LXXXV; *De tactu*, XI, XVIII). Cf. Blaise [1], and *TLL*. Both Noltinius (col. 508) and Krebs & Schmalz reject it.
- *divisibilis*, -e (NF) – ‘divisible’ (*De sono*, LXVIII; *De tactu*, XIII, XIV). Cf. Blaise [1], and *TLL*. Both Krebs & Schmalz and Noltinius (col. 508) reject it.
- *ecclesiasticus*, -a, -um (LW) – ‘of the church’, from the Greek ἐκκλησιαστικός (*De modis*, CVII). Cf. Blaise [1], and *TLL*.

- *efformo*, 1 (NF) – ‘shape’ (*De sono*, XI, XII, XV, XXXII). Cf. Blaise [1], and *TLL*. It is rejected by both Noltinius (col. 519) and Krebs & Schmalz.
- *energia*, -ae (LW) – ‘power, strength’, from the Greek ἐνέργεια (*De modis*, XCIX). Cf. *TLL*, and Blaise [1].
- *essentialiter* (NF) – ‘essentially’ (*De modis*, CXIX). Cf. Blaise [1], and *TLL*, s.v. *essentialis*, 864, 46 ff. Noltinius (col. 1439) rejects it.
- *fluidum*, -i (R) – ‘fluid’ (*De sono*, VI, XLI). As a noun the word is a hapax in Classical literature in Columella 8.16.1 (*TLL*, s.v. *fluidus*, 954, 6 ff.).
- *fusor*, -is (NF) – ‘founder [in metals]’ (*De sono*, XL). Cf. Blaise [1], and *TLL*.
- *illustratio*, -onis (R) – ‘clearness’ (*De sono*, XI, LVII, LXXXI). Hapax in Classical literature in Quint. *inst.* 6.2.32.
- *impetuosus*, -a, -um (NF) – ‘impetuous’ (*De sono*, X). Cf. Blaise [1], and *TLL*. While Noltinius (col. 563) rejects it, some scholars defended it as allegedly attested in Pliny the Elder (cf. Krebs & Schmalz).
- *impraegno*, 1 (NF) – ‘impregnate’ (*De sono*, LXI). Cf. Blaise [1], and *TLL*. Noltinius (cols. 564 f.) rejects it.
- *incommensurabilis*, -e (NF) – ‘incommensurable’ (*De sono*, XXXIX, LXXIII). Cf. Blaise [1], and *TLL*.
- *inconceptibilis*, -e (NF) – ‘inconceivable’ (*De modis*, CII). Cf. Blaise [1], and *TLL*.
- *indivisibilis*, -e (NF) – ‘indivisible’ (*De modis*, CXI). Cf. Blaise [1], and *TLL*. Krebs & Schmalz reject it. Noltinius (col. 508), however, while rejecting *divisibilis*, hesitatingly approves of *indivisibilis* due to an alleged saying by Scaurus, a grammarian living under Hadrian.
- *insensibilis*, -e (NF) – ‘imperceptible’ (*De modis*, CX). Cf. Blaise [1], and *TLL*. Both Krebs & Schmalz and Noltinius (col. 582) reject it.
- *intermedius*, -a, -um (NF) – ‘intermediary’ (*De sono*, XXXIX). Considered as both pre-Classical and late Latin, due to an alleged occurrence in Varro (Blaise [1], and *TLL*). Neither Krebs & Schmalz nor Noltinius disapprove of it.
- *intrinsecus*, -a, -um (NS) – ‘inward’ (*De sono*, IX). Cf. Blaise [1], s.v. *intrinsecus*, II; and *TLL*, s.v. 2 *intrinsecus*. Noltinius (col. 590) rejects this usage as an adjective.
- *irregularis*, -e (NF) – ‘irregular’ (*De sono*, V, VII, VIII, XV, XXX, LI, LIII, LXXIII, LXXVIII). Cf. Blaise [1], *TLL*. It was, however, rejected as medieval in Noltinius (col. 594) and Krebs & Schmalz.
- *irregularitas*, -atis (NF) – ‘irregularity’ (*De sono*, XII). Cf. Blaise [1], Souter, and Krebs & Schmalz. Noltinius (col. 594) rejected it as medieval.
- *mediare*, 1 (NF) – ‘mediate’ (*De sono*, LXI). Cf. Blaise [1], and *TLL*, s.v. *medio*, 559, 10 ff. Both Krebs & Schmalz and Noltinius (col. 612) reject it, the latter even calls the usage in the sense of ‘aiding’, as in our case, *vehementer barbare*.

- *melancholia*, -ae (LW) – ‘melancholy’, from the Greek μελαγχολία (*De modis*, CVI). Cf. Blaise [1], and *TLL*. Both Noltinius (col. 1039) and Krebs & Schmalz reject it.
- *memorare*, 1 (NS) – ‘memorize’ (*De tactu*, VIII). Cf. *TLL*, s.v. *memoro*, 691, 74 ff.; and Forcellini, s.v. *memoro*, 2. Both Noltinius (cols. 613 f.) and Krebs & Schmalz reject it.
- *modernus*, -a, -um (NF) – ‘modern’, ‘contemporary’ (*De modis*, C; *De tactu*, XVI). Cf. Blaise [1], and *TLL*. Both Noltinius (col. 620) and Krebs & Schmalz disapprove of it. See Helander 2004, p. 130.
- *multoties* (NF) – ‘many times’ (*De sono*, XVIII). Cf. *TLL*, and Blaise [1]. Both Krebs & Schmalz and Noltinius (col. 625) reject it, the latter however being somewhat uncertain due to an alleged occurrence of the word in an epitome of Livy.
- *omnimode* (NF) – ‘in every way’ (*De sono*, XLV). Cf. Blaise [1], and *TLL*. Both Krebs & Schmalz and Noltinius (cols. 638 and 1078) reject it, Noltinius labelling it *suspectum*.
- *organa* [n. pl.] (LW) – ‘human organs’, from the Greek ὄργανον (*De sono*, II, III, IV, XVI, LVII; *De modis*, CI; *De tactu*, I). Cf. *TLL*, s.v. *organum*, 969, 63 ff.; and Blaise [1], s.v. *organum*, 2.
- *oscitantia*, -ae (NF) – ‘vanity, unconcernedness’ (*De tactu*, XI). Cf. Souter; and Matthiae. Both Noltinius (col. 643) and Krebs & Schmalz reject it.
- *particularis*, -e (NF) – ‘particular’ (*De sono*, XXXI, LVIII, LXVII). Cf. Blaise [1], and *TLL*. Rejected in both Noltinius (col. 647) and Krebs & Schmalz (see the commentary on XXXI).
- *patheticus*, -a, -um (LW) – ‘affecting, pathetic’, from the Greek παθητικός (*De tactu*, XVII). Cf. *TLL*, and Souter. Krebs & Schmalz reject it.
- *perceptibilis*, -e (NF) – ‘perceptible’ (*De modis*, CXI). Cf. Blaise [1], and *TLL*. Both Noltinius (col. 651) and Krebs & Schmalz reject it.
- *peregre* (NF) – ‘very excellent’ (*De sono*, *grat.* 3). First attested (as the adjective *peregre*) in Apulejus *Apol.* 37.
- *perpetim* (NF) – ‘constantly’ (*De modis*, ded.). Cf. Blaise [1], and *TLL*. For a long time it was considered to be attested in Pliny the Elder (cf. JPG, L&S).
- *perplurimus*, -a, -um (NF) – ‘very many’ (*De sono*, XXVI, LII, LVIII, LX, LXXXIII; *De modis*, CVII, CIX). Cf. Blaise [1], and Forcellini. Krebs & Schmalz reject it.
- *pertransire*, 4 (R) – ‘go through’ (*De sono*, XI, XLV). Hapax in Classical literature in Plin. *nat.* 37.68, but more common in late Latin (Blaise [1], Souter, Krebs & Schmalz).
- *porus*, -i (LW) – ‘pore’, from the Greek πόρος (*De sono*, LXI, LXIII). Cf. Blaise [1], and *TLL*, s.v. 2 *porus*. Both Krebs & Schmalz and Noltinius (col. 668) reject it.
- *practicus*, -a, -um (LW) – ‘active in practice’, from the Greek πρακτικός (*De sono*, LXVIII, LXXV; *De modis*, CIX, CXIIX, CXX). Cf. *TLL*, and

Forcellini. Noltenius (col. 671) approves of the word as an adjective, due to alleged occurrence in Quintilian, among others. In Krebs & Schmalz it is rejected.

- *productio*, -onis (NF) – ‘production’ (*De sono*, XXVII; *De modis*, LXXXIV). Cf. *TLL*, s.v. *productio*, 1644, 58 ff.; and Souter.
- *proficius*, -a, -um (NF) – ‘profitable’ (*De tactu*, X). Cf. Blaise [1], and *TLL*. Both Noltenius (col. 686) and Krebs & Schmalz reject it.
- *promptitudo*, -inis (NF) – ‘eagerness, readiness’ (*De sono*, CXVI). Cf. Blaise [1], and *TLL*. Both Noltenius (col. 688) and Krebs & Schmalz reject it.
- *proportionaliter* (NF) – ‘proportionally’ (*De sono*, IV, XXIX, XXXV, XXXIX, LX). Cf. Blaise [1]; *TLL*, s.v. 2 *proportionalis*; and Krebs & Schmalz, s.v. *proportionalis*. It is rejected as being without authority in Noltenius (col. 690).
- *proportionatus*, -a, -um (NF) – ‘proportioned’ (*De sono*, IV, IX, XII, IXX, XXX, XXXIII, XXXVII, XLV, LIV, LVI, LXXX, LXXXII; *De tactu*, V). Cf. *TLL*, s.v. *proportio*; and Du Cange. Noltenius (col. 690) rejects the word, and suggests alternative expressions.
- *putrefactio*, -onis (NF) – ‘decay, corruption’ (*De sono*, VI). Cf. Blaise [1], and *TLL*.
- *quoad* [+accusative] (R) – ‘with respect to’ (*De sono*, XII, XXX, XXXVI, XL, LI, LIV, LV, LVIII, LXIV; *De modis*, LXXXIV, CI, CIX, CXII, CXVI; *De tactu*, VI). Cf. Forcellini, s.v. *quoad*, III. Both Krebs & Schmalz and Noltenius (col. 1702) reject the usage.
- *rarefio* (R) – ‘rarefy’ (*De sono*, VI). Hapax in Classical literature in Lucr. 1.648.
- *reciproce* (NF) – ‘reciprocally’ (*De sono*, XIX, XXXIII). Cf. Blaise [1], and Souter). Both Krebs & Schmalz and Noltenius (col. 703) reject it.
- *reflexio*, -onis (NF) – ‘reflection’ (*De sono*, LXIV, LXV; *De modis*, LXXXIV). Cf. Blaise [1], and Souter. It is rejected in Krebs & Schmalz.
- *repercussio*, -onis (R) – ‘repercussion’ (*De sono*, LXV). The word is a hapax in Classical literature in Sen. *Nat.* 7.19.1.
- *resistentia*, -ae (NF) – ‘resistence’ (*De sono*, XXIX, XXXV, XXXVI, XXXVIII). Cf. Blaise [1], and Souter. It is rejected in Noltenius, (col. 711), and Krebs & Schmalz (see the commentary on *De sono*, XXIX).
- *saccharon*, -i (LW) – ‘sugar’, from the Greek σάκχαρον (*De sono*, LXXVI). Hapax in classical literature in Plin. *nat.* 12.32.
- *sensatio*, -onis (NF) – ‘understanding [by the senses]’ (*De sono*, I, IV; *De tactu*, I, II). Cf. Blaise [1], Souter, and Du Cange, s.v. *sensatio*, I. Here almost ‘perception’ (cf. Hoven).
- *sensibiliter* (NF) – ‘perceptibly’ (*De sono*, XV, LXII; *De modis* CXIV). Cf. Blaise [1], and Souter. The adjective *sensibilis* is rejected in both Krebs & Schmalz and Noltenius (col. 1168).

- *sensualis*, -e (NF) – ‘sensitive, sensual’ (*De modis*, CI). Cf. Blaise [1], and Souter. Noltenius (col. 727) considers it to be typical of the ecclesiastical writers of late antiquity.
- *sextuplus*, -a, -um (NF) – ‘six times as much’ (*De sono*, XXXVIII). Cf. Forcellini.
- *sphaeroides*, -is (LW) – ‘spherical globe’, from the Greek σφαίροειδής (*De sono*, XXII; *De tactu*, VI). Cf. Forcellini, Latham, s.v. *spheroids*, and *OED*, s.v. *spheroid*.
- *sphaerula*, -ae (NF) – ‘small sphere’ (*De sono*, VII, VIII). Cf. Blaise [1], and Souter.
- *successive* (NF) – ‘step by step, successively’ (*De modis*, CXIIX). Cf. Blaise [1]. Both Krebs & Schmalz (s.v. *successivus*) and Noltenius (col. 738) reject it.
- *tantum* (NS) – ‘so [equivalent to *tam*]’ (*De sono*, XII). Cf. Blaise [1], s.v. *tantum*, 1; Souter; Sz. p. 592, and Löfstedt 1928, pp. 266 f.
- *textus*, -us (NS) – ‘text’ (*De modis*, CXX). Cf. Blaise [2], and Latham. Noltenius (col. 751) and Krebs & Schmalz reject it.
- *theoreticus*, -a, -um (LW) – ‘theoretical’, from the Greek θεωρητικός (*De modis*, CXI, CXIII). Cf. Blaise [1], and Souter. Krebs & Schmalz (s.v. *theoreticus* and *practicus*) reject it.
- *tractatus*, -us (NS) – ‘writing, tract’ (*De modis*, C; *De tactu*, XVI, XVII, XX). Cf. Blaise [1], s.v. *tractatus*, 3. Both Noltenius (col. 754) and Krebs & Schmalz reject it.
- *transversim* (NF) – ‘transversely, crosswise’ (*De tactu*, X, XIII). Cf. Blaise [1], and Souter.
- *variabilis*, -e (NF) – ‘changeable’ (*De sono*, XLI). Cf. Blaise [1], and Souter.
- *vibratio*, -onis (NF) – ‘vibration’ (*De sono*, *passim*; *De modis*, LXXXIV, XCVI, CX, CXXI; *De tactu*, II, III, IV, V, VI, XVIII). Cf. Blaise [1], and Souter. It is rejected in Krebs & Schmalz (s.v. *vibramen*).
- *vibrissare*, 1 (NF) – ‘trill’ (*De sono*, LXXXI). First attested in Paulus Diaconus’s *Fest.* p. 370.

Medieval

- *amorousus*, -a, -um (NF) – ‘amorous’ (*De modis*, XCIX). Cf. *DMLBS*, and Blaise [2].
- *aqueus*, -a, -um (NF) – ‘that has to do with water’ (*De sono*, LIV). Cf. Blaise [2], and *DMLBS*. JPG, however, claimed it could be attested in Varro. See Helander 2004, p. 88.
- *bombarda*, -ae (NF) – ‘cannon’ (*De sono*, LXII). Cf. *DMLBS*, s.v. *bombardus*, and Blaise [2] (see the commentary).
- *cancellarius*, -i (NS) – ‘chancellor’ (*De sono*, ded.). Cf. *DMLBS*; *LLNMA*, s.v. *cancellarius*, 4; and Helander 2004, p. 205.

- *chorus*, -i (NS) – ‘chancel’ (*De sono*, LXVI). Cf. Blaise [2], and *DMLBS*, s.v. *chorus*, 4, a. Noltenius (col. 460) rejects it.
- *circulariter*, (NF) – ‘in a circle’ (*De sono*, XXII). Cf. Blaise [2], *DMLBS*.
- *consul*, -is (NS) – ‘chief magistrate [*borgmästare*]’ (*De modis*, CXX). Cf. Blaise [2], s.v. *consul*, 2; *GMLS*, s.v. *consul*, 2; and JPG.
- *copia*, -ae (NS) – ‘copy’ (*De modis*, CXX). Cf. Blaise [2], and *DMLBS*, s.v. *copia*, 4. Both Noltenius (col. 1370) and Krebs & Schmalz reject it.
- *dispositive*, (NF) – ‘dispositively’ (*De sono*, XXVII). Cf. *DMLBS*, and Blaise [2].
- *fluiditas*, -atis (NF) – ‘fluidity’ (*De sono*, VII, VIII). Cf. *DMLBS*, Hoven and Bartal.
- *globus*, -i (NS) – ‘bullet, cannon-ball’ (*De sono*, XXXI). Cf. *DMLBS*, 2, d; *GMLS*; and Helander 2004, p. 183.
- *miraculosus*, -a, -um (NF) – ‘miraculous’ (*De modis*, LXXXV). Cf. Blaise [2], and *DMLBS*. Both Noltenius (col. 618) and Krebs & Schmalz reject it.
- *papyraceus*, -a, -um (NS) – ‘made of paper’ (*De sono*, LXII). Cf. *DMLBS*; Hoven; JPG; and BFS (see the commentary).
- *paragraphus*, -i (NS) – ‘paragraph’, from the Greek παράγραφος (*De tactu*, X, XIII). Cf. Blaise [2], and *DMLBS*, s.v. *paragraphus*, 2. Neither Noltenius (cols. 1628 f.) nor Krebs & Schmalz reject it (see the commentary on *De tactu*, X).
- *periodus*, -i (NS) – ‘period [of time]’, from the Greek περίοδος (*De tactu*, IV, VI). Cf. Blaise [2]; *DMLBS*, s.v. *periodus*, 2; and *LLNMA*, s.v. *periodus*, 2, a. Krebs & Schmalz reject it.
- *perpendiculariter* (NF) – ‘vertically’ (*De sono*, VII, XII). Cf. Blaise [2], *DMLBS*. Noltenius (col. 653) rejects it, and suggests the classical *ad perpendicularum* (also used by Vallerius in thesis 12 below).
- *perinde* [+form of *esse*] (NS) – ‘it does not matter’ (*De sono*, LXIV; *De tactu*, VII). Cf. *LLNMA*. It is rejected by Krebs & Schmalz (see the commentary on *De sono*, LXIV).
- *porosus*, -a, -um (NF) – ‘porous’ (*De sono*, IX). Cf. Blaise [1], *DMLBS*, and Bartal. Both Noltenius (col. 668) and Krebs & Schmalz reject it.
- *practicus*, -i (LW) – ‘practician’, from the Greek πρακτικός (*De sono*, LXXV, LXXVIII; *De modis*, CVI, CXVII, CXIX; *De tactu*, V, VII, XI, XII). Cf. *DMLBS*, s.v. *practicus*, 2, and Blaise [2]. Both Krebs & Schmalz and Noltenius (col. 671) reject the word as a noun.
- *praecise* (NF) – ‘precisely’ (*De sono*, XII, XIX, XXXVII, XXXVIII, LXXIV; *De tactu*, XXI). Cf. Blaise [2], and *DMLBS*, s.v. *praecise*, 2. It is rejected by Noltenius (col. 672).
- *praeludium*, -i (NF) – ‘prelude’ (*De tactu*, XX). Cf. Blaise [2], and *DMLBS*, s.v. *praeludium*, 2. Krebs & Schmalz reject it.
- *praesupponere*, 3 (NF) – ‘presuppose’ (*De modis*, CXX). Cf. Blaise [2], and *DMLBS*. Both Noltenius (col. 680) and Krebs & Schmalz reject it.

- *pulvis pyrius* (MT) – ‘gun powder’ (*De sono*, LXII). Cf. Du Cange, *DMLBS*, s.v. *pulvis*, 5; and Helander 2004, pp. 217 ff. (see the commentary).
- *respectivus*, -a, -um (NF) – ‘relative’ (*De sono*, LVII, LXXI). Cf. Du Cange, Blaise [2], and Latham. Both Krebs & Schmalz and Noltenius (col. 712) reject it.
- *saltem* (NS) – ‘only’ (*De sono*, XXVIII, XXXVIII, LXXXII, *grat.* 2). Cf. *LLNMA*, s.v. *saltem*, 1, b; Matthiae; and JPG. BFS, Noltenius (col. 1156), and Krebs & Schmalz reject it (see the commentary on *De sono*, XXVIII).
- *sclopetum*, -i (NF) – ‘gun, firearm’ (*De sono*, VIII, LIII, LXV). Cf. *LLNMA*, s.v. *sclopetus*; and Helander 2004, pp. 193 ff. (see the commentary on *De sono*, VIII).
- *secundum minutum* (MT) – ‘second’ (*De sono*, XXIV, LVI; *De tactu*, IV, VII). Cf. *LLNMA*, s.v. *secundus*, II, B, 2; and Niermeyer (see the commentary on *De sono*, XXIV).
- *senator*, -is (NS) – ‘councillor’ (*De sono*, ded.). Cf. *LLNMA*, s.v. *senator*, b; *GMLS*, s.v. *senator*, 2, b; and Helander 2004, p. 210.
- *senatus*, -us (NS) – ‘council’ (*De modis*, ded.). Cf. *LLNMA*, s.v. *senatus*, 1, a; *GMLS*, s.v. *senatus*, 2; and Helander 2004, p. 210.
- *sigillatus*, -a, -um (NF) – ‘sealed’ (*De sono*, LV, LXI). Cf. *LLNMA*, s.v. *sigillo*, B, 1, b. Both Krebs & Schmalz and Noltenius (col. 729) reject it (see the commentary on *De sono*, LV).
- *tarantula*, -ae (NF) – ‘wolf-spider’ (*De sono*, LXXXIII). Cf. Du Cange, and Zedler, s.v. *tarantel* (see the commentary).
- *undiquaque* (NF) – ‘all sides around’ (*De sono*, XI, XII, XXXVIII). Cf. *LLNMA*, s.v. *undequaque*; and Hoven. Both Noltenius (col. 769) and Krebs & Schmalz reject it.

Neo-Latin

- *campanisterium*, -i (NF) – ‘bell-tower’ (*De sono*, LXXX). See the commentary.
- *cylindricus*, -a, -um (NF) – ‘cylindrical’ (*De sono*, LXVIII). Cf. Hoven, and Latham.
- *focus*, -i (NS) – ‘focal point’ (*De sono*, XLII, LXVI). Cf. Latham, and Krebs & Schmalz.
- *funependulum*, -i (NF) – ‘pendulum’ (*De sono*, XVII, XXXIII; *De tactu*, XXI). Cf. Gehler 1833, p. 304.
- *iudex provincialis* (MT) – ‘chief judge in a district of jurisdiction’ (*De sono*, ded.). Cf. Helander 2004, p. 208.
- *legio praetoria* (MT) – ‘life-guard regiment’ (*De modis*, CXVI). Cf. Helander 2004, pp. 184 and 187 (see the commentary).
- *qua* [+accusative] (NS) – ‘as regards’ (*De tactu*, XII). Cf. Östlund 2000, p. 63, Örneholm 2003, pp. 132 ff.; and Eskhult 2007, pp. 228 f. (see the commentary).

- *sexpeda*, -ae (NF) – ‘six feet, fathom’ (*De sono*, LVI). See the commentary.
- *tormentum*, -i (NS) – ‘cannon, artillery’ (*De sono*, XXXI, LVI, LVII, LX, LXII). Cf. Helander 2004, pp. 188 f.
- *typographus*, -i (NF) – ‘printer’ (*De sono*, title). From the Greek τύπος and γραφεύς. Cf. Hoven; Pitkäranta 1992, p. 130; Helander 2004, pp. 223 ff., and Krebs & Schmalz, s.v. *typus*.

Scientific vocabulary

Rare Classical and late Latin

- *hypomochlium*, -i (LW) – ‘fulcrum’ (*De sono*, XIX, XXII). From the Greek ὑπομόχλιον. Hapax in Classical literature in Vitruvius 10.3.3.
- *mechanica*, -ae (LW) – ‘mechanics’, from the Greek μηχανικός (*De sono*, XIX, LV). Cf. *TLL*, s.v. *mechanicus*, 516, 16 ff. Noltenius (col. 611) rejects it for *mechanica ars* or *mechanice*.
- *numerus compositus* (MT) – ‘a number which is the product of two or more factors, greater than unity’ (*De tactu*, IX). Cf. *TLL*, s.v. *compositus*, 2133, 22 ff.; Tropicke 1921, p. 96; and *OED*, s.v. *composite*, A, 3, a.
- *peripatus*, -i (LW) – ‘place for walking, lecture of Aristotle’s, from the Greek περίπατος’ (*De sono*, grat. 1). Cf. Blaise [1], and *TLL*. For Noltenius (col. 326), however, it means *disputatio philosophica* (see the commentary).
- *praedicamentum*, -i (NF) – ‘category’ (*De modis*, CI). Cf. Blaise [1], and *TLL*. Both Noltenius (col. 673) and Krebs & Schmalz (s.v. *praedicare*) reject it (see the commentary).
- *primus [numerus]* (MT) – ‘prime [number]’ (*De sono*, LXVIII; *De tactu*, IX). Cf. Tropicke 1921, p. 96; and Micraelius 1661, col. 898 (see the commentary).
- *rectilineus*, -a, -um (NF) – ‘rectilinear’ (*De sono*, coroll.). Cf. Forcellini, and Souter.
- *resonantia*, -ae (R) – ‘resonance’ (*De sono*, LXVIII). Hapax in Classical literature in Vitruvius 5.3.
- *subduplus*, -a, -um (NF) – ‘twice contained [in another number]’ (*De sono*, XIX). Cf. Blaise [1], and Souter.
- *subjectum*, -i (NS) – ‘substance (opp. accident)’ (*De sono*, IV, LXI; *De tactu*, II, XVIII). Cf. L&S, and Blaise [1], s.v. *subiectum*, 1 (see the commentary on *De sono*, IV).
- *terminus*, -i (NS) – ‘each of the quantities that form a ratio, and each of the quantities that form a series’ (*De modis*, LXXXIIX, CXI; *De tactu*, XI). Cf. *OED*, s.v. *term*, IV [note]; and Blaise [1], s.v. *terminus*, 4 (see the commentary on *De modis*, LXXXIIX).

Medieval

- *a posteriori* (MT) – ‘inductively’ (*De modis*, LXXXVII). Cf. Latham, Blaise [2], s.v. *posterior* (see the commentary).
- *accidens reale* (MT) – ‘*accidens* (occasional or non-essential property) that is inherent in the form of a thing’ (*De sono*, I). Cf. Micraelius 1661, col. 22 (see the commentary).
- *affectio*, -onis (NS) – ‘affection [property]’ (*De tactu*, I, III, VI). Cf. Blaise [2]; *OED*, s.v. *affection*, III; and Micraelius 1659, cols. 69 ff. (see the commentary).
- *aqua fortis* (MT) – ‘nitric acid’ (*De sono*, LXI). Cf. *DMLBS*, s.v. *aqua*, 5; and *OED*, s.v. *aquafortis* (see the commentary).
- *argentum vivum* (MT) – ‘mercury, quicksilver’ (*De tactu*, XXI). Cf. *DMLBS*, s.v. *argentum*, 5; *OED*, s.v. *hydrargyrum*; and Hooper 1801, s.v. *hydrargyrus*.
- *caeteris paribus* (MT) – ‘all other things being equal’ (*De sono*, XIX, XXXIII). Cf. *DMLBS*, s.v. *ceterus*, 2; *OED*, s.v. *ceteris paribus*, and Micraelius 1661, col. 227.
- *ciphra*, -ae (LW) – ‘number’ (*De modis*, CXX). Cf. Blaise [2], s.v. *cifra*, and *DMLBS*, s.v. *cifra*. Noltenius (col. 461) rejects this originally Arab word (see the commentary on *De modis*, CXX, but also Helander 2004, p. 146).
- *corollarium*, -i (NS) – ‘corollary, appendix’ (*De sono*, *coroll.*; *De modis*, *coroll.*). Cf. *DMLBS*, s.v. *corollarium*, b; *OED*, s.v. *corollary*, 3 (see the commentary on *De sono*, *coroll.*).
- *decanus*, -i (NS) – ‘dean [at university]’ (*De tactu*, title). Cf. Niermeyer, s.v. *decanus*, 12; *DMLBS*, s.v. *decanus*, 9; and Hoven, s.v. *decanus*, C. Noltenius (cols. 494 f.) rejects it.
- *denominator*, -is (NS) – ‘denominator’ (*De tactu*, XIV). Cf. *DMLBS*; *OED*, s.v. *denominator*, 2; and Solvang, s.v. *nevner*.
- *effervescentia*, -ae (NF) – ‘excitement [med.]’ (*De modis*, XCIX). Cf. *LLNMA*, Hoven, and Bartal. Noltenius (col. 566) rejects it.
- *filamentum*, -i (NS) – ‘filament’ (*De tactu*, I). Cf. *DMLBS*, s.v. *filamentum*; and *OED*, s.v. *filament*, 1, a (see the commentary).
- *fractio*, -onis (NS) – ‘fraction’ (*De tactu*, XIV). Cf. *DMLBS*, s.v. *fractio*, 5, b; *OED*, s.v. *fraction*, 5, a; and Micraelius 1661, col. 525.
- *hermetice* (NF) – ‘hermetically’ (*De sono*, LV). Cf. *DMLBS*, and Matthiae (see the commentary).
- *incidentia*, -ae (NS) – ‘incidence’ (*De sono*, LXIV). Cf. *DMLBS*, s.v. *incidentia*, 1; and *OED*, s.v. *incidence*, 4 (see the commentary).
- *integer*, -gra, -grum (NS) – ‘integer [denoting whole number]’ (*De tactu*, XIV). Cf. *DMLBS*, s.v. *integer*, 9, c; and *OED*, s.v. *integer*, A, 3.
- *manuductio*, -onis (NF) – ‘introduction, compendium’ (*De modis*, XCIX). Cf. Blaise [2]; *LLNMA*, s.v. *manuductio*, 2, c; Hoven; and Helander 2004,

p. 169. Both Noltenius (col. 608) and Krebs & Schmalz reject it, noticing the frequent usage of this word, especially in titles of new books.

- *meteora* [n. pl.] (NS) – ‘atmospheric phenomena’, from the Greek μετήορα (*De sono*, V, LXII). Cf. *DMLBS*, s.v. *meteorus*, 1; BFS, s.v. *meteoros*, and *OED*, s.v. *meteor*, A, 2 (see the commentary on *De sono*, V).
- *modus*, -i (NS) – ‘mode [phil.]’ (*De tactu*, III). Cf. Blaise [2], s.v. *modus*, 4; *DMLBS*, s.v. *modus*, 9; *OED*, s.v. *mode*, 6, a; and Micraelius 1661, col. 783 (see the commentary).
- *numerator*, -is (NS) – ‘numerator’ (*De tactu*, XIV, XV). Cf. Solvang, s.v. *teller*; and *OED*, s.v. *numerator*, 1, a.
- *numerus fractus* (MT) – ‘fraction’ (*De tactu*, XIV, XV). Cf. *DMLBS*, s.v. *frangere*, 6, d; Solvang, s.v. *brøk*; and Micraelius 1661, col. 525 (see the commentary on *De tactu*, XIV).
- *numerus radicalis* (MT) – ‘square root number’ (*De sono*, XXXIV, LXXI, LXXIV; *De modis* XCII). See the commentary on *De sono*, XXXIV.
- *objectum*, -i (NS) – ‘object’ (*De sono*, LXIV, LXV, LXXXII; *De modis*, LXXXIV; *De tactu*, I, IX). Cf. Blaise [2], and *DMLBS*, s.v. *obicere*, 6. Both Krebs & Schmalz and Noltenius (cols. 634 f.) label it as an unclassical philosophical *terminus technicus* (see the commentary).
- *operatio*, -onis (NS) – ‘operation, activity’ (*De sono*, VI, XXIII). Cf. Blaise [2], s.v. *operatio*, 2; *DMLBS*; *OED*, s.v. *operation*, I, 1, a; and Micraelius 1661, col. 929 (see the commentary on *De sono* XXIII).
- *pellicula*, -ae (NS) – ‘membrane [med.]’ (*De tactu*, IV, XVIII). Cf. *DMLBS*, s.v. *pellicula*, 2; *LLNMA*; Blanckaert 1748; and *OED*, s.v. *pellicle* and *pellicule*.
- *plumbum calcinatum* (MT) – ‘litharge’ (*De tactu*, XXI). Cf. *DMLBS*, s.v. *calcinare* and *calcinatio*; *OED*, s.v. *litharge*, and *calcine*; and Hooper 1801, s.v. *oxydum plumbi semivitreum*.
- *qualitas audibilis* (MT) – ‘sound’ (*De sono*, grat. 1). The term has its origins in scholastic philosophy. Cf. Blaise [2], s.v. *qualitas*, and Micraelius 1661, cols. 1188 f.
- *sinus*, -us (NS) – ‘sine’ (*De sono*, XIX). Cf. Latham. An incorrect translation of the allegedly Arab word *jiva* (see the commentary).
- *solutio*, -onis (NS) – ‘changing from a solid or gaseous to a liquid state’ (*De sono*, VI). Cf. *OED*, s.v. *solution*, II, 5; cf. Barta, s.v. *solutio*, 2.
- *supponere*, 3 (NS) – ‘assume’ (*De sono*, II, VII, XII, XV, LXI; *De modis*, CVI, CXIII). Cf. Blaise [2], and Latham. Both Krebs & Schmalz and Noltenius (col. 744) reject it.
- *tympanum auris* (MT) – ‘ear-drum’ (*De tactu*, XIX). Cf. *LLNMA*, s.v. *tympanum*, 2; *OED*, s.v. *tympanum*, 2; and Dorland’s *Illustrated Medical Dictionary* 1965, s.v. *tympanum*.

Neo-Latin

- *atmosphaera*, -ae (NF) – ‘atmosphere’ (*De sono*, V). From the Greek ἀτμός and σφαῖρα. Cf. *OED*, s.v. *atmosphere*, 1, and Micraelius 1661, col. 189.
- *chronometron* (NF) – ‘instrument that measures time’, from the Greek χρόνος and μέτρον (*De tactu*, XXI). Cf. *SAOB*, s.v. *kronometer*; *OED*, s.v. *chronometer* (see the commentary).
- *determinatio*, -onis (NS) – ‘direction’ (*De sono*, IX, LXIV; *De tactu*, III). Cf. *OED*, s.v. *determination*, 7, a (see the commentary on *De sono*, IX).
- *disputatio*, -onis (NS) – ‘printed dissertation’ (*De sono*, title, grat. 2; *De modis*, title, CXVI; *De tactu*, title, II, VI). Cf. Marti 1994.
- *ellipsis*, -is (LW) – ‘ellipsis [math.]’, from the Greek ἔλλειψις (*De sono*, XLII). Cf. Micraelius 1661, col. 431 (see the commentary).
- *ellipticus*, -a, -um (LW) – ‘elliptical’, from the Greek ἑλλειπτικός (*De sono*, LXVI). Cf. Latham. It is rejected in Krebs & Schmalz (s.v. *ellipsis*).
- *magnetismus*, -i (NF) – ‘magnetism’ (*De sono*, LXXXIII). Cf. Latham; Zedler, s.v. *magnetismus*; and *OED*, s.v. *magnetism*, 1, b (see the commentary).
- *medium*, -i (NS) – ‘intervening substance, medium’ (*De sono*, IV, XXX, LIII, LV, LVIII, LXIII; *De modis*, LXXXIV, CI). Cf. Micraelius 1661, cols. 745 f., and *OED*, s.v. *medium*, 5, a (see the commentary on *De sono*, IV).
- *parabolicus*, -a, -um (NF) – ‘parabolic’, from the Greek παραβολικός (*De sono*, LXVI). Cf. Latham (see the commentary).
- *thesis*, -is (NS) – ‘theme of a learned investigation’, from the Greek θέσις (*passim*). Cf. Noltenius col. 1196 (see commentary on *De sono*, I).
- *undulatio*, -onis (NF) – ‘undulation’ (*De tactu*, II, IV). Cf. *OED*, s.v. *undulation* (see the commentary on *De tactu*, II).

Music vocabulary

Rare Classical and late Latin

- *harpa*, -ae (LW) – ‘harp’, from the Greek ἄρπη (*De modis*, CXII). Cf. Blaise [1], and *TLL*, s.v. *harpa* (see the commentary).
- *bisdiapason* (NF) – ‘double octave’ (*De modis*, XCIII). Cf. Blaise [1], and Forcellini.
- *comma*, -atis (LW) – ‘the pitch interval of 81 to 80’, from the Greek κόμμα (*De modis*, XCII, CX, CIV). Cf. Blaise [1], s.v. *comma*, 3; and *TLL*, s.v. *comma*, 1817, 73 ff. (see the commentary on *De modis* XCII).
- *compositor*, -is (NS) – ‘composer’ (*De modis*, CXX). Cf. *TLL*, and Blaise [1], 2.
- *consonantia*, -ae (R) – ‘consonance’ (*De sono*, XXXVI, LXXI, LXXII, LXXIII, LXXIV, LXXV, LXXVI, LXXX, LXXXIII; *De modis*, LXXXIV,

XCI, XCIV, CXI, CXIV; *De tactu*, VI, XVI). Hapax in Vitruvius 5.5.7 in Classical literature.

- *diatonicus*, -a, -um (LW) – ‘diatonic’, from the Greek διατονικός (*De modis*, XXCIX, XCIV). Cf. *TLL*, and Souter.
- *diesis*, -is (LW) – ‘quarter tone’, from Greek διέσις (*De sono*, LXXXII). Hapax in Classical literature in Vitruvius 5.4.3 (see the commentary).
- *dissonantia*, -ae (NF) – ‘dissonance’ (*De sono*, LXXI, LXXIII, LXXVIII, LXXIX, LXXX, LXXXII, LXXXIII; *De modis*, LXXXIV, XCII, CXI; *De tactu*, VI, XVI). Cf. Blaise [1], and *TLL*. Both Krebs & Schmalz and Noltinius (col. 1150) reject it.
- *ditonus*, -i (LW) – ‘the interval of two tones’, the Greek δίτονος (*De sono*, XXXIX). Cf. Blaise [1], *TLL*, and Walther.
- *excellens*, -tis (NS) – ‘tone of the highest register [tetrachord]’ (*De sono*, XXX). Cf. *TLL*, s.v. *excello*, 1217, 1 ff., and Adams (see the commentary).
- *melodia*, -ae (LW) – ‘melody’, from the Greek μελωδία (*De sono*, LXXV; *De modis*, LXXXV, CII, CVII, CIX, CXVI, CXIX, CXX; *De tactu*, XIII, XIX). Cf. Blaise [1]; *TLL*; and *HMT*, s.v. *melodia*, I. It is rejected in Krebs & Schmalz (see the commentary on *De sono*, LXXV).
- *organicus*, -a, -um (NF) – ‘of an organ’ (*De sono*, XXIV). Cf. *TLL*, s.v. *organicus*, 967, 46 ff. See the commentary (*fistula organica*).
- *plausus*, -us (NS) – ‘[the hand’s sign of] beat’ (*De tactu*, X, XI). Cf. *TLL*, s.v. *plausus*, 2373, 34 ff.; and Walther (see the commentary on *De tactu*, X).
- *psalmus*, -i (LW) – ‘psalm [of David], hymn’, from the Greek ψαλμός (*De sono*, LXII; *De modis*, CVII, CIX). Cf. Blaise [1], and *TLL* (see the commentary on *De modis*, CVII).
- *semitonium*, -i (NF) – ‘semitone’ (*De modis*, XCII, XCIV, XCV, XCVII, CVI, CIIX, CXI, CXVII; *De tactu*, XX). Cf. L&S, and Forcellini. Noltinius (col. 727) rejects it in favour of *hemitonium*, which occurs in Vitruvius.
- *sesquialtera* [*proportio*] (NS) – ‘sesquialter [proportion]’ (*De sono*, LXVIII; *De tactu*, VIII, XI, XIII, XIV). Cf. Forcellini, s.v. *sesquialter*, and Walther, s.v. *proportio sesquialtera* (see the commentary on *De sono* LXVIII).
- *systema*, -atis (LW) – ‘system of musical modes’, from the Greek σύστημα (*De modis*, CXIX). Cf. Forcellini, Blaise [1], Souter, and Walther.
- *tonus*, -i (NS) – ‘mode’ (*De modis*, XCVIII, C, CXVI, CXIX, CXXI). Cf. Walther, s.v. *tonus*, 3; *GMO*, s.v. *tonus* (iv) (see the commentary on *De modis*, XCVIII).
- *tripla* [*proportio*] (NS) – ‘triple [proportion]’ (*De sono*, LXVIII, LXX; *De modis*, *coroll.*; *De tactu*, VIII, IX, XI, XII, XIII, XIV, XV, XVIII). Cf. Forcellini, s.v. *tripplus*, and Walther, s.v. *tripola* (see the commentary on *De sono*, LXVIII).
- *tympanotriba*, -ae (LW) – ‘drummer’, from the Greek τυμπανοτρίβης (*De tactu*, XX). Hapax in ancient Latin literature in Plaut. *Truc.* 611.

- *unisonus*, -a, -um (NF) – ‘unison’ (*De sono*, XXIV, LXXXII; *De modis*, XCIII). Cf. Forcellini, and Souter.

Medieval

- *altus*, -i (NS) – ‘the voice below the soprano’ (*De modis*, CXXI). Cf. *HMT*, s.v. *Altus* / *Alt*, *bassus* / *Bass*; *GMO*; and Walther, s.v. *alto* (see the commentary).
- *arcus*, -us (NS) – ‘bow [for string instruments]’ (*De sono*, XLIII, LXX). Cf. *LML*; Walther, s.v. *arco*, and Adams, s.v. *arco*.
- *b durum* (MT) – ‘natural b [square b]’ (*De modis*, CV, CVI, CVII, CIX, CXIIX). Cf. *DMLBS*, s.v. *B*, 2, a; *LLNMA*, s.v. *durus*, 3; and *GMO*, s.v. *dur* (see the commentary on *De modis*, CV).
- *b molle* (MT) – ‘b flat’ (*De modis*, CV, CVI, CVII, CIX, CXIIX). Cf. *DMLBS*, s.v. *B*, 2, b, and *mollis*, 5; and *GMO*, s.v. *dur* (see the commentary on *De modis*, CV).
- *bassus*, -i (NF) – ‘lowest voice in a polyphonic composition’ (*De modis*, CXXI). Cf. *LML*; *GMO*; and Walther, s.v. *basis* (see the commentary).
- *cadentia*, -ae (NF) – ‘cadence’ (*De modis*, CII, CVII, CIIX). Cf. *LML*, s.v. *cadentia*, 3; and Bartal (see the commentary).
- *clausula*, -ae (NS) – ‘cadence’ (*De modis*, LXXXIIX). Cf. *DMLBS*, s.v. *clausula*, 2, a; *HMT*, s.v. *clausula*, III; *LML*, s.v. *clausula*, 2; and Walther (see the commentary).
- *clavicymbalum*, -i (NF) – ‘harpsichord [or other unfretted keyboard string instrument]’ (*De modis*, CXII, CXIV). Cf. Walther; *LML*; *DMLBS*; *LLNMA*; Praetorius 1619, II, pp. 62 f.; and *GMO*, s.v. *harpsichord*.
- *clavis*, -is (NS) – ‘tone’ (*De sono*, XXX). Cf. *HMT*, s.v. *clavis*, IV; *LML*, s.v. *clavis*, 4; *GMO*, s.v. *clef*; and Walther, s.v. *chiave* (see the commentary).
- *clavis*, -is (NS) – ‘tonal limit’ (*De modis*, XC). Cf. *LML*, s.v. *clavis*, 1; and *HMT*, s.v. *clavis*, II (see the commentary).
- *compositus*, -a, -um (NS) – ‘polyphonic’ (*De modis*, CXX). Cf. *LML*, s.v. *compositus*, 5; Tinctoris, s.v. *cantus compositus*; and *GMO*, s.v. *cantus* (*i*).
- *consonantia composita* (MT) – ‘composite consonance’ (*De sono*, LXXI). Cf. Walther (s.v. *Consonantiae compositae*), and *LML*, s.v. *consonantia simplex* (see the commentary).
- *consonantia perfecta* (MT) – ‘perfect consonance’ (*De sono*, LXXIV, LXXV, LXXVI, LXXX; *De modis*, LXXXIV, XCI, CXIV). Cf. *LML*, s.v. *consonantia perfecta*, and Burmeister 1993[1606], p. 50 (see the commentary on *De sono*, LXXIV).
- *consonantia simplex* (MT) – ‘simple consonance’ (*De sono*, LXXI). Cf. Walther (s.v. *Consonantiae simplices*), and *LML*, s.v. *consonantia simplex* (see the commentary).

- *diminutio*, -onis (NS) – ‘diminution’ (*De sono*, LXVIII; *De tactu*, XI, XX). Cf. *LML*, s.v. *diminutio*, III; *HMT*, s.v. *diminutio*, II; *GMO*, s.v. *diminution*, and Walther, s.v. *diminutione*.
- *dulcinum*, -i (NF) – ‘curtal’ (*De modis*, CXII). Cf. *LML*, s.v. *dulcina*; Walther, s.v. *Dulcino*; *GMO*, s.v. *dulcian* (*i*); and Praetorius 1619, II, p. 38 (see the commentary).
- *fis* (NF) – ‘sharp F’ (*De modis*, CVII). Cf. *LML*, and *GMO*.
- *floridus*, -a, -um (NS) – ‘decorated, ornamented’ (*De modis*, CXX). Cf. *LML*; *GMO*, s.v. *florid*; and Walther, s.v. *Fiorito*.
- *fuga*, -ae (NS) – ‘canon’ (*De modis*, CXX). Cf. *GMO*, s.v. *fugue*; *LML*; *HMT*; and Walther, s.v. *Fugha* (see the commentary).
- *fusa*, -ae (NF) – ‘quaver’ (*De tactu*, VIII, XIV). Cf. *GMO*, s.v. *quaver* (see the commentary on *De tactu*, VIII).
- *gravis*, -e (NS) – ‘tone of the low register [tetrachord]’ (*De sono*, XXX). See the commentary.
- *harmonice*, -es (NS) – ‘harmony’, from the Greek ἀρμονικός (*De modis*, CXX). Cf. *LML*, s.v. *harmonica* (*harmonice*), 3 (see the commentary).
- *instrumentum*, -i (NS) – ‘music instrument’ (*passim*). Cf. *LLNMA*, s.v. *instrumentum*, 1, b; *DMLBS*, s.v. *instrumentum*, 5; and *LML*.
- *ligatura*, -ae (NS) – ‘ligature’ (*De modis*, CXX). Cf. *DMLBS*, s.v. *ligatura*, 5, a; *LLNMA*, s.v. *ligatura*, 5, a; Tinctoris; and *GMO*, s.v. *ligature* (*i*) (see the commentary).
- *longitudo*, -inis (NS) – ‘duration’ (*De sono*, LXVIII; *De modis*, LXXXIV; *De tactu*, III, IV, VI, VII). Cf. *DMLBS*, s.v. *longitudo*, 6, d; Walther; and Lippius 1612, fol. B5r.
- *magadium*, -i (LW) – ‘bridge’, the Greek μαγάδιον (*De sono*, XLIII, LVIII). Cf. *LLNMA*, s.v. *magadia*; and Walther (see the commentary on *De sono* XLIII).
- *mensura*, -ae (NS) – ‘measure [according to which musical time is estimated]’ (*De sono*, LXVIII, LXIX, LXX; *De modis*, CII, CIII, CIX; *De tactu*, *passim*). Cf. *DMLBS*, s.v. *mensura*, 2, f (see the commentary on *De sono*, LXVIII).
- *minima*, -ae (NF) – ‘minim’ (*De tactu*, VIII, XIV). Cf. *HMT*; and *GMO*, s.v. *minim* (see the commentary on *De tactu*, VIII).
- *modus*, -i (NS) – ‘mode’ (*De sono*, LXXV, LXXXIII; *De modis*, *passim*). Cf. Blaise [2], s.v. *modus*, 1; and *DMLBS*, s.v. *modus*, 10, c (see the commentary).
- *motetta*, -ae (LW) – ‘motet’, from Italian *mottetto* (*De modis*, CII, CVII). Cf. Blaise [2], s.v. *motetum* (*motetus*), and *DMLBS*, s.v. *motetus* (see the commentary on *De modis*, CII).
- *notula*, -ae (NS) – ‘note’ (*De sono*, XXXIX, LXVIII; *De modis*, LXXXV, CXVI, *coroll.*; *De tactu*, VII, VIII, IX, X, XII, XIV, XV). Cf. *DMLBS*, *notula*, 3; and Blaise [2], s.v. *notula*, 1. See the commentary on *De sono*, XXXIX.

- *prolatio*, -onis (NS) – ‘prolation [*mensura*]’ (*De tactu*, VIII, XVI). Cf. *DMLBS*, s.v. *prolatio*, 7; *HMT*, s.v. *prolatio*, III; and *GMO*, s.v. *notation*, §III, 3, (iii) (see the commentary).
- *pulsare*, 1 (NS) – ‘play [all kinds of instruments]’ (*De sono*, *passim*; *De modis*, CIII; *De tactu*, V, VII, XX). Cf. Blaise [2], s.v. *pulso*, 1; *DMLBS*, s.v. *pulso*, 4; and *GMO*, s.v. *pulsator organorum*.
- *repercussio*, -onis (NS) – ‘the most important interval of each mode [i.e. synonymous with *tenor*]’ (*De modis*, XCIX). Cf. *HMT*, s.v. *repercussio*, III; *OED*, s.v. *repercussion*, 3, b; and Walther (see the commentary).
- *scala*, -ae (NS) – ‘scale’ (*De modis*, XXCIX, XCIV, XCV, CX, CXII, CXIII). Cf. *LLNMA*, s.v. ¹*scala*, c.
- *semidiapente* (NF) – ‘semidiapente [the half of a fifth]’ (*De modis*, XCII). See the commentary.
- *semiditonus*, -i (NF) – ‘minor third’ (*De modis*, CVI). Cf. *LLNMA*, Latham, and Walther (s.v. *semiditono*).
- *semifusa*, -ae (NF) – ‘semiquaver’ (*De tactu*, VIII, XIV). Cf. *GMO*, s.v. *semiquaver* (see the commentary on *De tactu*, VIII).
- *semiminima*, -ae (NF) – ‘crotchet’ (*De tactu*, VIII, XIV). Cf. *HMT*; *GMO*, s.v. *crotchet*; and *LLNMA*, s.v. *semiminima* (see the commentary on *De tactu*, VIII).
- *simplex*, -icis (NS) – ‘monophonic’ (*De modis*, CXX). Cf. Tinctoris s.v. *cantus simplex*; *GMO*, s.v. *simplex*, 1; and Walther, s.v. *canto semplice* (see the commentary).
- *superior*, -ius (NS) – ‘tone of the higher register [tetrachord]’ (*De sono*, XXX). See the commentary.
- *symphonia*, -ae (NS) – ‘string keyboard instrument’ (*De modis*, CXII). Cf. *MGG*, s.v. *symphonia*, II, 2; *GMO*, s.v. *symphonia* (ii); and Praetorius 1619, II, p. 62 (see the commentary).
- *syncopatus*, -a, -um (NS) – ‘syncopated’ (*De modis*, CXX). Cf. Tinctoris, s.v. *sincopa*; Walther, s.v. *syncopatio*; and *OED*, s.v. *syncopation*, 3, a (see the commentary).
- *tactus*, -us (NS) – ‘a unit of time (beat) measured by a movement of the hand’ (*De sono*, LXVIII, LXIX, LXX, LXXXIII; *De modis*, LXXXIV, CIII, *coroll.*; *De tactu*, *passim*). Cf. *HMT*, s.v. *tactus*, IV; *GMO*; Latham; and Bartal, s.v. *tactus musici* (see the commentary on *De sono*, LXVIII).
- *tenor*, -oris (NS) – ‘tenor’ (*De modis*, CXXI). Cf. *GMO*; and Walther, s.v. *tenore* (see the commentary).
- *testudo*, -inis (NS) – ‘lute’ (*De sono*, XXVI, LXXXII; *De modis*, CXII). Cf. Walther, and *GMO*.
- *transpositio*, -onis (NS) – ‘transposition’ (*De modis*, CXIIX). Cf. *LLNMA*, s.v. *transpositio*, c (see the commentary).
- *tritonus*, -i (LW) – ‘tritone’, from the Greek τρίτονος (*De modis*, XCII, XCIV). Cf. Blaise [2]; Du Cange; and *HMT*, s.v. *tritonus*, II (see the commentary on *De modis*, XCII).

- *valor*, -is (NS) – ‘time-value’ (*De sono*, LXVIII; *De tactu*, VIII). Cf. Latham.
- *viola*, -ae (LW) – ‘instrument of the viol- or violin-family’, from Italian *viola* (*De sono*, XXVI, LVIII, LXXX; *De modis*, CXII, CIV, CXII, CXIV, CXVIII). Cf. *MGG*, s.v. *Viola*, I; *GMÖ*, s.v. *viola*, 2; and Walther (see the commentary on *De sono*, XXVI).
- *vox*, -is (NS) – ‘part’ (*De modis*, CII, CXXI; *De tactu*, VIII). Cf. *GMÖ*, s.v. *part* (ii) (see the commentary on *De modis*, CII).

Neo-Latin

- *bassettus*, -i (LW) – ‘bassett’, from Italian *bassetto* (*De modis*, CXXI). Cf. *GMÖ*, s.v. *Bassett* (i) (see the commentary).
- *bassus generalis* (MT) – ‘thorough bass’ (*De sono*, LXX; *De modis*, CXII). Cf. *GMÖ*, s.v. *Generalbass* (see the commentary).
- *battuta*, -ae (LW) – ‘beat, measure’, from Italian *battuta* (*De modis*, CIII; *De tactu*, VII, X, XI). Cf. Praetorius 1619, III, p. 48; and Walther (see the commentary on *De modis*, CIII).
- *buccina*, -ae (NS) – ‘cornett [Ger. *Zink*]’ (*De modis*, CXII). Cf. Walther; Praetorius 1619, II, pp. 2 and 35; and *GMÖ*, s.v. *cornett* (see the commentary).
- *cantus*, -us (NS) – ‘soprano part’ (*De modis*, CXXI). Cf. *GMÖ*, s.v. *cantus* (i) (see the commentary).
- *castanetae* [f. pl.] (NF) – ‘castanets’ (*De sono*, XXXI, LXVIII, LXX). Cf. Walther, s.v. *castagnettes*; and *GMÖ*, s.v. *castanets* (see the commentary on *De sono* XXXI).
- *chelys*, -is (NS) – ‘an arched string instrument’, from the Greek χέλυς (*De sono*, XXVI, LXXXI; *De modis*, CIII, CXI, CXII). Cf. Walther, and *GMÖ* (see the commentary on *De sono*, XXVI).
- *chelys vulgaris* (MT) – ‘keyed fiddle [*nyckelgiga*]’ (*De modis*, CIII). See the commentary.
- *cijthara*, -ae (NS) – ‘cittern’, from the Greek κιθάρα (*De modis*, CXII). Cf. Praetorius 1619, II, p. 54; *LML*, s.v. *cithara*; and *GMÖ*, s.v. *cittern*.
- *cithara Hispanica* (MT) – ‘guitar’ (*De tactu*, XX). Cf. Mersenne 1648, p. [ii]9; Walther, s.v. *Chitarra*; and *GMÖ*, s.v. *guitar*, 4 (see the commentary).
- *clavarium*, -i (NS) – ‘keyboard’ (*De modis*, CXII). Cf. Walther (see the commentary).
- *clavulus*, -i (NS) – ‘tuning peg’ (*De sono*, XLI). See the commentary.
- *concentus universalis* (MT) – ‘in the manner of *chorus* [*chormessig*]’ (*De modis*, CXV, CXVI, CXXI). Perhaps invented by Vallerius (see the commentary on *De modis*, CXV).
- *fundamentum*, -i (NS) – ‘bass-part’ (*De sono*, LXX; *De modis*, CXII). Cf. Burmeister 1993[1606], p. 42, and Walther, s.v. *fundamento* (see the commentary on *De sono*, LXX).

- *harmoniosus*, -a, -um (NF) – ‘harmonious’ (*De modis*, XCIX). See the commentary.
- *latitudo*, -inis (NS) – ‘volume’ (*De sono*, XXX, XL, XLIV, XLV, XLVII, LI, LIII, XLIV, XLV, LVIII, LIX, LXVIII; *De modis*, LXXXIV, LXXXIX, CXVI; *De tactu*, III, V). Cf. Walther, s.v. *latitudo soni*, and Lippius 1612, fol. B5v (see the commentary on *De sono*, XXX).
- *lyra*, -ae (NS) – ‘harp [or other string instrument]’ (*De sono*, XXVI; *De modis*, CXII; *De tactu*, XVIII). Cf. MGG, s.v. *Leiern*, B, I; JPG; BFS; Matthiae; and GMO, s.v. *Lyra* (ii).
- *lyra mendicorum* (MT) – ‘instruments such as hurdy-gurdy, keyed fiddle, hommel’ (*De modis*, CXII). Cf. Adams, s.v. *lyra mendicorum*, and Apel 1972, p. 496 (see the commentary).
- *melotacticus*, -a, -um (NF) – ‘melotactic [melodic rhythmic]’, from the Greek μέλος and the Latin *tactus* (*De sono*, CXX). See the commentary.
- *musarithmicus*, -a, -um (NF) – ‘musarithmic [music arithmetic]’, from the Greek Μουσική and ἀριθμός (*De modis*, CXX). See the commentary.
- *musurgicus*, -i (NF) – ‘music theorist’, created from the Greek μουσουργός (*De sono*, XXVIII; *De tactu*, V, VII, IX, XVI). See the commentary on *De sono*, XXVIII.
- *octupedalis*, -e (NF) – ‘of eight feet [organ pipe]’ (*De sono*, XXIV). See the commentary.
- *palmula*, -ae (NS) – ‘key of a *Klavier* instrument’ (*De sono*, XXIII). Cf. Zedler, and Adams (see the commentary).
- *pandora*, -ae (NS) – ‘bandora’ (*De modis*, CXII). Cf. Praetorius 1619, II, pp. 53 f.; Walther, s.v. *pandura*; and GMO, s.v. *bandora* (see the commentary).
- *Polonessa*, -ae (LW) – ‘polonaise’, from the French *polonaise* (*De tactu*, XII). Cf. GMO, s.v. *polonaise* (see the commentary).
- *polyplectrus*, -a, -um (NF) – ‘[instruments] with many plectra’ (*De sono*, XIII, XXVI, XLVI, LXX; *De modis*, CXII; *De tactu*, XIX). From the Greek πολύς and πλῆκτρον. Cf. Adams.
- *profunditas*, -atis (NS) – ‘pitch’ (*De sono*, XXX, XXXIV, XXXVI, XLI, XLIV, LXVIII; *De modis*, LXXXIV, CXVI, CXXI; *De tactu*, III, VI, VII). Not found in other authors (see the commentary on *De sono*, XXX).
- *proportio*, -onis (NS) – ‘*Proportz* [*Nachtanz*]’ (*De tactu*, XII). Cf. GMO, s.v. *Proportz*, and *Nachtanz* (see the commentary).
- *schisma*, -atis (NS) – ‘the pitch interval of 81 to 80’, from the Greek σχίσμα (*De modis*, CX, CXI). Cf. Descartes 1978, p. 36 (see the commentary on *De modis* CX).
- *sonata*, -ae (LW) – ‘music piece [usually for instrumental ensemble]’, from the Italian *sonata* (*De tactu*, VII). Cf. HMT; GMO; Praetorius 1619, III, p. 24; and Walther (see the commentary).

- *spinetta*, -ae (LW) – ‘spinet’, from Italian *spinetta* (*De modis*, CXII). Cf. Walther; *GMO*, s.v. *spinet*; and Praetorius 1619, II, p. 62 (see the commentary).
- *symphonia*, -ae (NS) – ‘music piece [usually for instrumental ensemble]’ (*De tactu*, VII). Cf. *GMO*, s.v. *sinfonia* (i); Walther; and Praetorius 1619, III, p. 24 (see the commentary).
- *tabula*, -ae (NS) – ‘soundtable, belly’ (*De sono*, XL, LVIII). Cf. Walther, s.v. *table*. See the commentary on *De sono*, XL.
- *tonographicus*, -a, -um (NF) – ‘tonographic [tones expressed in records]’, from the Greek τόπος and γραφικός. (*De modis*, CXIX). See the commentary.
- *tuba ductilis* (MT) – ‘sackbut’ (*De modis*, CXII, CXVI). Cf. Walther, and *GMO*.
- *tuba marina* (MT) – ‘trumpet marine’ (*De sono*, LVIII). Cf. Walther, s.v. *tromba marina*; and *GMO*, s.v. *trumpet marine* (see the commentary).
- *varius nervorum concentus* (MT) – ‘scordatura [förstämningh]’ (*De modis*, CXIX). Perhaps invented by Vallerius (see the commentary).
- *viola major* (MT) – ‘bass instrument of the viol- or violin-family’ (*De sono*, LXXX; *De modis*, CXII). Cf. Walther, and *GMO*, s.v. *viola da gamba* (see the commentary on *De sono*, LXXX).
- *violinum*, -i (LW) – ‘violin [soprano]’, from Italian *violino* (*De modis*, CXI, CXIX). Cf. Walther (s.v. *violino*); *MGG*, s.v. *Viola*, I; and *GMO*, s.v. *violin*.

Vernacular music terms

- *adagio* (It) – ‘slowly’ (*De tactu*, VII, XIII). Cf. Praetorius 1619, III, pp. 51, and 244; Walther; and *GMO* (see the commentary).
- *aftropp* (Sw) – ‘military signal for ordering the forces to troop off or disperse’ (*De tactu*, XX). Cf. *SAOB*, s.v. *aftropp*, a; and *OED*, s.v. *troop*, v, 3.
- *allegro* (It) – ‘swiftly’ (*De tactu*, VII, XIII). Cf. *GMO*; and Walther (see the commentary).
- *baassviol* (Sw) – ‘bass instrument of the viol- or violin-family’ (*De modis*, CXII). Cf. Walther, s.v. *Basse de Viole*; and *GMO*, s.v. *viola da gamba* (see the commentary on *De sono*, LXXX).
- *basun* (Sw) – ‘sackbut’ (*De modis*, CXVI). Cf. Walther, s.v. *Posaune* (see the commentary).
- *claver* (Sw) – ‘polyplectrum instrument [harpsichords, spinets, etc.]’ (*De sono*, XXVI). Cf. *GMO*, s.v. *Klavier*, 2 (see the commentary).
- *chormässigh / chormessig* (Sw) – ‘in the way of a chorus’ (*De sono*, XXXVI; *De modis*, CXV). Cf. Walther, s.v. *choro*, 2 (see the commentary on both instances).
- *chorum* (Sw) – ‘military signal for assembling the forces to prayers’ (*De tactu*, XX). Cf. *SAOB*, s.v. *korum*.

- *cornett* (Sw) – ‘cornett [Zincke]’ (*De sono*, XXXI). Cf. Walther, s.v. *cor-netto*; Praetorius 1619, II, pp. 35 f.; and *GMO*, s.v. *cornett* (see the commentary).
- *förgalring* (Sw) – ‘military signal for assembling the forces for marching off’ (*De tactu*, XX). Cf. *SAOB*, s.v. *förgaddring*, 2; and *OED*, s.v. *troop*, n, 4.
- *förstämningh* (Sw) – ‘scordatura [*Verstimmung*]’ (*De modis*, CXIX). Cf. *GMO*, s.v. *scordatura* (see the commentary).
- *forte* (It) – ‘strongly’ (*De tactu*, V). Cf. *GMO*; and Walther (see the commentary).
- *grave* (It) – ‘slowly’ (*De tactu*, XIII). Cf. *GMO*; and Walther (see the commentary).
- *långspeel* (Sw) – ‘hommel’ (*De modis*, CXII). Cf. *GMO*, s.v. *hommel* (see the commentary).
- *largo* (It) – ‘very slowly’ (*De tactu*, XIII). Cf. *GMO*; and Walther (see the commentary).
- *marche* (Sw) – ‘military signal to march’ (*De tactu*, XX). Cf. *SAOB*, s.v. *marsch*, 3; and *OED*, s.v. *march*, n⁵, II, 2, a.
- *mordant* (Sw) – ‘mordent’ (*De modis*, CXIV). Cf. *GMO*, s.v. *mordent*; and Walther, s.v. *Mordant* (see the commentary).
- *nyckelgijga* (Sw) – ‘keyed fiddle’ (*De modis*, CXII; *De tactu*, XVIII). Cf. *GMO*, s.v. *nyckelharpa* (see the commentary on *De modis*, CXII).
- *piano* (It) – ‘weakly’ (*De tactu*, V). Cf. *GMO*, s.v. *piano* (*i*); and Walther (see the commentary).
- *Poloness* (Sw) – ‘polonaise’ (*De tactu*, XII). Cf. *GMO*, s.v. *polonaise* (see the commentary).
- *proportion* (Sw) – ‘*proportz* [*Nachtanz*]’ (*De tactu*, XII). Cf. *GMO*, s.v. *Proportz*, and *Nachtanz* (see the commentary).
- *puka* (Sw) – ‘kettledrum’ (*De modis*, CIII; *De tactu*, XX). Cf. Swedberg (see the commentary on *De modis*, CIII).
- *regal* (Sw) – ‘regal’ (*De sono*, LXX). Cf. *GMO*, s.v. *regals*; *OED*, s.v. *regal*, n³; and Walther, s.v. *regale*, 3 (see the commentary).
- *rewalie* (Sw) – ‘military signal to awaken the personnel’ (*De tactu*, XX). Cf. *SAOB*, s.v. *revelj*; and *OED*, s.v. *reveille*, 1.
- *snarrwärck* (Sw) – ‘rattling stop’ (*De sono*, XXVI). Cf. Zedler, s.v. *Schnarr-Werck*; and *GMO*, s.v. *Schnarrwerk* (see the commentary).
- *trumma* (Sw) – ‘drum’ (*De sono*, LVIII; *De modis*, CIII; *De tactu*, XX). Cf. Swedberg (see the commentary).
- *trumpet marin* (Sw) – ‘trumpet marine’ (*De sono*, LVIII). Cf. Walther, s.v. *tromba marina*; and *GMO*, s.v. *trumpet marine* (see the commentary).
- *trumpetstycken* (Sw) – ‘trumpet pieces’ (*De modis*, CXVI).
- *trumpett* (Sw) – ‘trumpet’ (*De modis*, CXVI). See the commentary.

Concluding reflections

In addition to what was said regarding vocabulary at the beginning of this section, we are at this stage able to make some further observations, having seen the account of neologisms and post-Classical words. For in the *music vocabulary* list it is clear to see that, besides the expected fact that the largest group is the one with words that entered into music discourse in the Middle Ages, the vast majority of them are nouns. Among the 111 words that are listed there (vernacular words excluded) we met only one verb (the NS *pulso*) and a total of 16 adjectives (four in late Latin [LL], six in medieval [ML], six in neo-Latin [NL]). The remaining 94 are nouns (18 in late Latin, 44 in medieval, 32 in neo-Latin). Among these we can then single out some special categories:

- Names of instruments, parts of instruments, and players of instruments are 27, viz. LL: *arpa*, *tympanotriba*; ML: *arcus*, *clavicymbalum*, *dulcinum*, *magadium*, *symphonia*, *testudo*, *viola*; NL: *buccina*, *castanetae*, *chelys*, *chelys vulgaris*, *cijthara*, *cithara Hispanica*, *clavarium*, *clavulus*, *lyra*, *lyra mendicorum*, *palmula*, *pandora*, *spinetta*, *tabula*, *tuba ductilis*, *tuba marina*, *viola major*, *violinum*.
- Music genres, techniques, forms and dances are seven: viz. LL: *psalmus*; ML: *fuga*, *motetta*; NL: *polonessa*, *proportio*, *sonata*, *symphonia*.
- Music theory is the principal component of the remaining group of 60 nouns (exceptions being e.g. *compositor* and *instrumentum*). Here we find 14 nouns from late Latin, 34 from medieval Latin, and 12 from neo-Latin.

Due to the ongoing development in the field, there was a constant need both for new terms and concepts, and for Latin designations of new instruments. The resulting great number of new nouns thus naturally reflects the very discipline itself, and its progress. The situation could be contrasted to that within the biological disciplines, for instance, where a great portion of the new words were in fact adjectives, which were needed for a thorough classification of the diverse species.

If we include all words (not only the nouns), 17 of 21 from late Latin, 41 of 52 from medieval Latin, and 16 of 38 from neo-Latin are mainly theoretical. Roughly speaking, this also mirrors the general fact that the foundations of music theory were primarily laid before the Renaissance, while new instruments were still created for several centuries to come.

1.5.2 Style

If pragmatism was one of the key words when the language of the dissertations was described in terms of grammar and vocabulary, the same can also be accepted, as we shall see, as a general characterization when we consider these concepts from a narrower stylistic perspective (admittedly, in reality the choice of words and grammar cannot be separated from style). Nevertheless, such a consideration, and what it reveals about the demands of the genre and the predilections of the authors, is worthwhile for several reasons. On the one hand, as has been remarked so many times above, the texts under investigation in this study are linguistically and stylistically different, a fact that in itself can indicate different authors in dissertations.¹⁰³ On the other hand, they all nevertheless mirror the generic stylistic ideals of the time, being the results of conscious and unconscious decisions taken by authors, who wanted to present learned discussions to the public.¹⁰⁴ Although they used a language that has in earlier research rightly been labelled as ‘highly conventionalised’,¹⁰⁵ for authors of academic dissertations at the time there was obviously also some license to make use of an individual characteristic style. This fact, both the conventionalism and the room for individual stylistic differences, must be understood from the situation and the discussions of style in scholarly prose at the time.

To begin with, for any author of the 17th century the dominant stylistic ideal, or even the stylistic framework in its entirety, was based on ancient rhetoric. But to the three *genera* (*judiciale*, *deliberativum*, *demonstrativum*) inherited from antiquity, the humanists had also added a fourth, viz. the *genus didascalium* (or *doctrinale*), which was intended especially for educatory and scholarly writings. There were certainly also models to be found in the ancient texts for authors of learned works; Cicero’s philosophical works had a very important role in this respect.¹⁰⁶ The language should here be simple and clear.¹⁰⁷ During the 17th century rhetoric had also been more and more restricted to the part of the text concerning *elocutio*, i.e. the usage of tropes and figures, at the expense of that of *inventio*, in which suitable arguments and topoi were suggested. This is a general phenomenon, which is clearly mirrored in the hand-books of the

¹⁰³ Cf. Eichler 1896, p. 25.

¹⁰⁴ Cf. e.g. Swales 1990, p. 58: “[the rationale of genre] shapes the schematic structure of the discourse and influences and constrains choice of content and style”.

¹⁰⁵ Östlund 2000, pp. 11 and 60 f.

¹⁰⁶ Helander, forthcoming [2].

¹⁰⁷ Benner & Tengström 1977, pp. 87 ff. Cf. Östlund 2000, p. 64.

time, where rhetoric and *elocutio* can sometimes almost be considered as synonyms.¹⁰⁸

For learned authors, however, there were in fact further alternatives. One could be found in scholastic Latin texts (there was a certain revival of scholasticism in the 17th century), another in texts written by scholars of the English new empiricism, including the Royal Society. Representatives of both of these ideals were inimical to the stylistic predominance of rhetoric, and regarded it as an obstacle for the communication between author and reader.¹⁰⁹ A similar view was held by the foremost philosopher of the 17th century, René Descartes, whose philosophy Vallerius explicitly adhered to. In the *Discours de la méthode* rhetoric is accordingly rejected as something that speaks to the feeling and fantasy of man, while language should only refer to the reality that is situated outside of it. Accepting the necessity of rhetoric, however, since men have to use language, and should thus use the form of it that is most suitable for persuasion, he advocated a style characterized by the rhetorical concept of *perspicuitas*, i.e. clarity, and a demonstration of facts *more geometrico*.¹¹⁰ For a clear language follows from a clear thought:

Ceux qui ont le raisonnement le plus fort, et qui digèrent le mieux leur pensées, afin de les rendre claires et intelligibles, peuvent toujours le mieux persuader ce qu'ils proposent, encore qu'ils ne parlent que bas breton, et qu'ils n'eussent jamais appris de rhétorique.¹¹¹

Worth remembering here is that while in traditional rhetoric clarity of thought belongs to *inventio*, and clarity of language to *elocutio*,¹¹² in Descartes thinking is closely linked to perception, and clear thoughts are thus the result of both empirical and logical reasoning. The latter of these can certainly only be used for previously discovered facts.¹¹³ In practice, however, Descartes at several times employs communicative techniques that are much more traditionally rhetorical than logical.¹¹⁴ Mersenne's techniques are similar, although he also strongly opposed a style that depended on or-

¹⁰⁸ Hansson 2006, p. 40 (with references), cf. e.g. France 1972, pp. 10 ff.; Dear 1988, p. 18; and Helander 2001, p. 18.

¹⁰⁹ Benner & Tengström 1977, pp. 87 ff. Cf. France 1972, pp. 37 f.

¹¹⁰ Fafner 1982, p. 233. Cf. France 1972, p. 48: "There is no need for any particular preparation of the audience or any appeal to the imagination, the passions, or the senses (as traditional rhetoric put it); the method is rhetoric enough". Admittedly, we also find, for instance, a similar striving for a scientific language characterized by complete rationality in Mersenne (cf. Gouk 1999, p. 176, and Dear 1988, p. 17).

¹¹¹ Quoted in France 1972, p. 40. Cf. Dear 1988, p. 189; Asmuth 2003, col. 853; and Rothkamm 2009, p. 205.

¹¹² Cf. Lausberg 1973, p. 274.

¹¹³ Cf. Gouhier 1955, p. 86: ... *la déduction cartésienne, au contraire, est inséparable de l'intuition qui perçoit des relations évidentes dans les notions évidentes. Les formes logiques peuvent servir à exposer la vérité déjà trouvée, non à la trouver.*

¹¹⁴ See further France 1972, pp. 52 ff.

namentation and empty eloquence. According to him, who stressed his own very simple and succinct style, the *inventio* and *dispositio* were naturally separated from and higher than the part of rhetoric that concerned nothing but the language.¹¹⁵ It has also been suggested that the dialectic form of Mersenne's discussion in fact mirrors the disputations that he used to take part in in Paris, and that it thereby conforms to the principles of rhetoric.¹¹⁶

When we describe the stylistic features of our dissertations it will turn out that the background sketched here is relevant, viz. the predominance of *elo-cutio* in rhetoric, and the allegedly anti-rhetorical strains visible in the learned society of the time. As we shall see, the concept of *perspicuitas* could to a varying degree actually be conceived of as a guiding principle for our authors as well. The characteristic elements and the differences that can be detected between the texts could, I think, be understood from such a perspective. First, however, we shall deal with the features of the texts that are common to them, and often to scientific discourse at the time in a general perspective.¹¹⁷ Thereafter, some especially frequent rhetorical devices in the texts shall be mentioned, and the account shall, for the abovementioned reasons, be almost exclusively limited to figures and tropes. Last in this section the language and style of the different dissertations shall be more closely compared.

Characteristic jargon

As was said above, scientific neo-Latin, just as scientific style quite generally, can justly be labelled as formalized. The same, or very similar, key words, phrases, and constructions usually recur repeatedly in one and the same text, and the reasons are thus to be found in the concept of genre. In discourse of this kind, clarity and precision were the governing ideals, and a well-established, clear and useful phraseology naturally serves this purpose.

To begin with, I shall in this section point to certain flagrant key words and phrases (formulas, as it were), which are common in scientific texts of the time, and by which the authors are able to specify, generalize, define and exemplify the matters under discussion using a well-established phraseology that was familiar to scholars within the same field. Thereafter, we shall focus on constructions and expressions that are strikingly frequent in our dissertations, and by which the authors construe their discussions mainly of causes and effects, natural as these are in investigatory texts, in which a demonstration of facts and their interdependence is made in a clear manner. After a section in which some examples of authorial statements of the probability of a certain matter, i.e. 'modifying expressions', have been accounted for, some

¹¹⁵ Dear 1988, pp. 17 f.

¹¹⁶ Seidel 1986, p. 59.

¹¹⁷ As a background for comparison the study on style reported in Östlund 2000, pp. 59 ff., in which more than 70 early modern academic dissertations are scrutinized (p. 31), is especially useful. See also the study in Örneholm 2003, pp. 76 ff., comprising 19 medical dissertations.

authorial meta-textual constructions shall be commented upon. Finally we shall meet some examples of authorial interaction with the reader and the praeses, as well as some very common ways of expressing ‘according to’.

Key words and phrases

- The word *institutum* occurs five times in the Classical sense of ‘aim, or purpose, of a work’, viz. *De sono*, VI; *De modis*, LXXXIV; *De tactu*, II, IV, and XVI. Two of these (*De sono*, VI; and *De modis*, LXXXIV) form part of the phrase *instituti ratio*. The usage is typical of scientific neo-Latin (cf. Östlund 2000, p. 63).
- The phrase *ita in reliquis* (‘likewise in other cases’) occurs nine times (*De sono*: VII, VIII, XII, XIX, XXV, XXXIV, XL, LXX [*omnibus*]; *De modis*: XCVII [*intervallis*], CX). It occurs also – just to mention two examples of very many from the time – in the scientific works of Marin Mersenne (1648, p. 38): *baculus enim alterius baculi duplus cum eo facit Octauam, et ita de reliquis intervallis*, and John Milton (1806, p. 212): *Quales autem res ipsae sunt, talis materia earum esse debet; sensibillum sensibilis, aeternarum aeternae; et ita in reliquis*.
- The construction *nec [nihil] obstat quod [quo minus]* (‘it is of no hindrance that’) occurs five times (*De sono*, V, VII, XXX, XXXV, LXIV). Being frequent in scholastic texts, the usage continues especially in scientific neo-Latin (cf. Krebs & Schmalz, s.v. *obstare*. As regards the translation, cf. DMLBS, s.v. *obsto*, 5, b).
- The phrase *caeteris paribus* (‘all other things being equal’) occurs twice (*De sono*, XIX, XXXIII). It is common in scholastic and later scientific Latin (cf. DMLBS, s.v. *ceterus*, 2; and OED, s.v. *ceteris paribus*; see the commentary on *De sono*, XIX). We find it, for instance, in Mersenne’s *Harmonicorum libri XII* (1648, p. 67): *Est autem certum fides, caeteris paribus, eo tremere validius ...*
- The phrase *caeteris positis* (‘the other things being posited’) occurs seven times (*De sono*, XXXIII; *De modis*, CII, CVI, CVII, CVIII, CIX, CXVI). It is formulaic, and typical of scientific discourse of the period. It can also be found, among many other instances, in Descartes’s *Principia philosophiae* (vol. 8, 1905, p. 68): *caeteris positis ut prius*.
- Similarly, the phrase *his positis* (‘these things being posited’) can be found twice (*De sono*, LXXX; *De modis*, CXXI). Occurring now and then in scholastic texts (e.g. in Thomas Aquinas’s *In IV sententiarum*, 4, 15, 4), it is also typical of argumentative discourse of the time of Vallerius, another example being found in Mersenne’s *Harmonicorum libri XII* (1648, p. 7): *His positis, ait vix ullam differentiam soni oriri ab eo quod pulsatur*, and in Galileo Galilei’s dialogue *De motu* (1890, p. 390): *His positis et demonstratis, sequitur necessario, in puncto reflexionis non dari quietem*.
- The phrase *quantum in se / ipsis est* (‘as much as it is in itself / themselves’) occurs four times (*De sono*, XLIV; *De modis*, CVI, CVIII, CIX). It

first occurs in the writings of the Church fathers, and then becomes formulaic. It can, for instance, be found at several instances both in Augustine (e.g. in *De continentia*, 2, 4, 25), and in Thomas Aquinas (e.g. in *De sortibus*, 4, 299).

- The phrase *ut voca[n]t* ('as they [he] call[s] them') occurs six times (*De modis*, LXXXIIX, CIII, CXII, CXIX, CXX; *De tactu*, XIV). It occurs frequently in dissertations of the time (Östlund 2000, p. 74). In our texts it is generally used when the author introduces neologisms, technical terms and concepts in the discussion, or sometimes vernacular expressions.
- The phrase *simul sumpti* [-ae, -a] ('taken [considered] together') can be found three times (*De sono*, XLII, *coroll.* [twice]). It occurs frequently in philosophical texts from the Middle Ages (e.g. in William of Ockham), and continues to be used in scientific neo-Latin discourse. We find it e.g. in Mersenne's *Harmonicorum libri XII* (1648, p. 5): *neque hi circuli simul sumpti augentur pro ratione numeri lapidum*, and in Galileo's *De motu* (1890, p. 332): ... *patet, celeritates omnes, in tripla proportione, sumptas simul, minores esse quam celeritas illa, quae earum maximae sesquialtera fuerit* ...
- The phrase *simul et semel* ('at one and the same time') can be found twice (*De modis*, CXV, CXIIX). First occurring in Ireneus's *Adversus haereses* (2.19.5), it becomes very common in philosophical texts from the Middle Ages (e.g. in Thomas Aquinas and William of Ockham), and continues to be so in scientific neo-Latin. We find it e.g. in Roger Bacon's *Perspectiva* (1996, p. 138): *Nam primo sequitur ex hoc quod res creata esset simul et semel in pluribus locis* ...
- The construction *quod ad ... pertinet* ('as far as ... is concerned') occurs twice (*De modis*, XCI, CVIII), and *quantum vero ad illud [pertinet]* (*De sono*, LIV) once. It can be found in Classical Latin, and becomes very common in scientific neo-Latin texts (cf. Östlund 2000, p. 63).

Constructions and expressions of causes and effects

Explanatory or consecutive constructions of the type with a preceding *hinc*, *inde*, *unde*, or a pronoun, and a following *ut*-clause, *quod*-clause, *accusativus cum infinitivo* or an indirect question occur numerous times in our dissertations.¹¹⁸ Thus we sometimes come across explanatory *quod*-clauses preceded by these constructions with *hinc*, *inde*, or *unde*. In ancient Latin the mood of

¹¹⁸ This type has also been suggested to be one of the two main variants for expressing causal relationship in scientific neo-Latin texts. Both variants contain three elements: the first expressing cause, the second certainty, and the third the prevailing state. The first element is then made up either of the subject or an adverbial, the second by a personal or impersonal verbal construction, and the third by a *quod*-clause, *accusativus cum infinitivo*, etc. (Helander, forthcoming [2]).

such clauses was usually the indicative, but here both the subjunctive and indicative occur.¹¹⁹

We meet, for instance, some instances of explanatory *quod*-clauses preceded by an *est* with *hinc* or *unde*:

- *hinc est quod* (*De sono*, LVIII [with both subjunctive and indicative], LXXX [with future tense])
- *unde ... est quod* (*De sono*, XXXI [indicative], LIII [indicative], LVIII [indicative], LXIV [indicative], LXXX [twice subjunctive, once future tense]; *De tactu*, XII [subjunctive])

Likewise, we meet several instances of such *quod*-clauses with the indicative or the subjunctive, preceded by impersonal constructions of verbs denoting evident circumstances, or *verba judicandi*, with *hinc*, *inde* or *unde*. In Classical Latin, we would expect to meet the *accusativus cum infinitivo*.¹²⁰

- *quod autem possint superficies ... vibrari, hinc constat* (*De sono*, XL)
- *hinc apparet, quod ... instrumenta pneumatica ... sint commodiora* (*De sono*, LXX)
- *hinc mirum nulli videbitur, quod nulla ... inventa fuit* (*De modis*, CII)
- *inde judicare audemus, quod ... fundantur* (*De tactu*, XIII)¹²¹

In some cases, however, the similar constructions with *hinc*, *inde*, *unde*, or *ex quo* [*ex quibus*] are followed by the ‘Classically correct’ *accusativus cum infinitivo*:

- *hinc ... constat vibrationes ... reflecti* (*De sono*, XXX)
- *unde evidenter probatur aërem ... repletum esse* (*De sono*, LIV)
- *unde manifestum est majorem ... discursum oriri* (*De tactu*, I)
- *unde proportionem duplam et triplam perceptioni facillimam omnium esse manifestum evadit* (*De tactu*, IX)
- *ex quibus cuius patet non solam sonorum varietatem ... militem hortari* (*De tactu*, XX)¹²²

Finally, in other instances we naturally meet such constructions followed by indirect questions:

¹¹⁹ Cf. Östlund 2000, pp. 40 f.

¹²⁰ K.-St., II, pp. 690 ff. Cf. Östlund 2000, p. 41.

¹²¹ Further examples are: *inde facile constat, quod ... intelligantur* (*De tactu*, IX); *unde facile videtur, quod ... sonus semper eodem modo conformatur ac dilatatur* (*De sono*, XXVII).

¹²² Further examples are: *ex quo ... constat ipsum aërem ... resistere posse* (*De sono*, XXX); *hinc ... constat hanc affectuum varietatem ... provenire* (*De modis*, CIX); *unde etiam ... cujusque mensurae tempus ... esse mutandum manifestum evadit* (*De tactu*, XI); *ex quo manifestum est ut majorem vim ita et majora spatia ... desiderari* (*De tactu*, VI).

- *unde facile apparet, quot modis ... sonum possint impedire* (*De sono*, LVIII)
- *ex his satis perspicuum est quatenus ... perfectae ac simplices sint* (*De sono*, LXXIV)
- *unde etiam exhinc constat, quam exiguum esse possit momentum* (*De sono*, LXXIX)
- *unde etiam patet, quam inconceptibilis mutationum multitudo ... emanare possit* (*De modis*, CII)

Moreover, a very frequent construction is the one with *fit*, with or without a pronoun or adverb in the principal clause, followed by a consecutive *ut*- or *quod*-clause in the subjunctive:

- *fiet ut* (*De sono*, XLVII, LII, LIV, LXXXIII)
- *quo ipso fit* [or *fiet*] *ut* (*De sono*, X, XIV)
- *hinc fit* [or *fiet*] *ut* (*De sono*, VIII, IX, XLI, XLIV [twice])
- *hinc fit quod* (*De modis*, LXXXVII)
- *unde ... fit quod* (*De sono*, LXX)
- *Unde factum est, ut* (*De tactu*, VIII)¹²³

We also find several instances of *sequitur*, with or without a pronoun or an adverb in the principal clause, followed by an accusative with infinitive, an *ut*- or a *quod*-clause, which is most often in the subjunctive:

- *ex quibus rebus* [or *ex hoc*, or *ideo*] ... *sequitur* + acc. with inf. (*De sono*, XV, XIX, LXXIV)
- *unde* [or *hinc*] *sequitur quod* + subjunctive (*De sono*, XIX, XLVI)
- *unde* [or *hinc*] *sequitur quod* + future tense (*De sono*, XLI, XLV [twice])
- *sequitur quod* + subjunctive (*De sono*, XLIX)
- *sequitur ut* + subjunctive (*De tactu*, XVI)

The usage in this last case notably differs from what has been observed in academic language in earlier research. Whereas Östlund, in whose corpus were mainly dissertations from the 18th century, stated that “*sequi* in combination with *inde* (*unde* etc.) is always construed in our texts with the *a.c.i.*”,¹²⁴ it can be noticed that this does not hold true for the dissertations in the present study, which were written somewhat earlier than the ones treated by Östlund. The unclassical *quod*-clause here appears at several instances.

¹²³ Further examples are: *eo ipso ... fit ut* (*De sono*, XXII); *unde fit ut* (*De sono*, LIX); *hoc ipso fit ut* (*De sono*, LXX); *qua fit ut* (*De modis*, C); *quo fit* [or *fiebat*] *ut* (*De sono*, XXXVI; *De modis*, CXV); *quo fit* [or *fiebat*] *ut* (*De sono*, XXXVI; *De modis*, CXV).

¹²⁴ Östlund 2000, p. 41.

The need for words referring to ‘cause’ or ‘reason’ is naturally related to the abovementioned purpose of the texts of discussing and explaining causes and their effects and consequences. In this sense we above all meet *causa* and *ratio*. Examples are:

- *existimo sonum cum omnibus suis differentiis ac causis posse demonstrari* (*De sono*, I)
- *causam proximam istius effectus nuncupari debere modeste statuamus* (*De tactu*, XVIII)
- *nulla enim ratio tunc esse potest, quare* (*De sono*, XII)
- *ex quibus tantum 12, ob rationes jam allatas, retinentur* (*De modis*, XCV)

The sense of the words differs in so far that *ratio* normally means ‘reasonable cause’, ‘cause of justification’, etc.

Modifying expressions

Equally natural in argumentative discourse are expressions stating the author’s view of the veracity of the matters under discussion, whether or not these are obviously true or false, plausible, or doubtful, i.e. questions connected with *evidentiality* or *epistemic modality*, to use the terms employed in modern linguistics. In accordance with the terminology of Östlund, we may here label them ‘modifying expressions’.¹²⁵

The one that occurs most frequently is that stating ‘it is evident’, or ‘it is well-known’.¹²⁶ Many times we meet impersonal constructions, often together with a preceding *hinc*, *inde*, *unde*, or *ex quo*, indicating a causal relationship:

- *facile apparet* (*De sono*, XXXV, XLII, LVIII, LXX), followed by an *a.c.i.* or indirect questions
- The *manifestum est* [*evadit*] (*De tactu*, I, VI, IX, XI, XIV), followed by an *a.c.i.*
- *certum* [*certissimum*] *est* [*manet*] (*De sono*, LIII, LIV, LVII, LXVIII, LXIX [twice]; *De tactu*, XII), followed by an *a.c.i.* or a consecutive *ut*-clause [LIV, preceded by *adeo*]
- *constat* (*De sono*, XXX [twice], XXXIV [twice], XXXVIII, XXXIX, XL [twice], XLII, LVIII, LXI, LXI, LXXIII, LXXVIII, LXXIX; *De modis*, CIX, CXVI, CXVII; *De tactu*, VI, IX, XIII, XIV), followed by an *a.c.i.*, a *quod*-clause in the subjunctive [*De sono* XL, *De tactu* IX], or an indirect question [LVIII, LXXIX]
- *notum* [*notissimum*, *notius*] *est* (*De sono*, V, IX, XII, XIX, XXIX, XXX, XXXVII, LIV, LVIII, LXVIII, LXIX, LXXVIII; *De modis* CXIV)

¹²⁵ Östlund 2000, pp. 74 ff.

¹²⁶ Cf. Östlund 2000, p. 75, and Örneholm 2003, pp. 86 f.

- *patet* (*De modis*, CII, CXI, CXVI; *De tactu*, XV, XX), followed by an *a.c.i.*, a *quod*-clause [with future tense], or an indirect question¹²⁷

However, the same verbs are often used also in various other constructions denoting evidentiality. We meet, for instance:

- *ratio jam apparet* (*De sono*, XXXII)
- *res est manifesta* (*De tactu*, XIII, XIX)
- *praxis ipsa satis confirmat* (*De modis*, CXIV)
- *hujus ratio infra patebit* (*De sono*, LXVII)
- *quam-maxime clarum est hoc* (*De sono*, VIII)
- *hoc longe clarissimum erit* (*De modis*, LXXXVI)¹²⁸

Probable or credible features are in our texts mainly expressed with a form of *credibilis* or *incredibilis*:

- *facile credibile est* (*De sono*, XII), followed by an *a.c.i.*
- *facile colligere possumus incredibile non esse* (*De sono*, LXII)
- *dixi incredibile non videri* (*De sono*, LXII)¹²⁹

In some, rather few, instances we meet expressions where the author wants to state that something is doubtful:

- *posset forsan dubitari* (*De sono*, LVI), followed by an indirect question (*num*)
- *jure dubitare queas* (*De tactu*, XIII), with an indirect question (*an*)
- *hinc dubitatio oritur* (*De tactu*, XIV, XXI), together with an indirect question (*an*)

At several times we meet expressions stating the difficulties involved in reaching valid conclusions, and that some circumstances sometimes cannot

¹²⁷ Further examples are: *apparet* (*De sono*, LXIX); *satis apparet* (*De sono*, XLII), followed by an indirect question, an *a.c.i.*, or a *quod*-clause; *perspicuum est* (*De sono*, LXXIV), followed by an indirect question; *facile videtur* (*De sono*, XXVII), followed by a *quod*-clause in the indicative; *mirum nulli videbitur* (*De modis*, CII), followed by a *quod*-clause in the indicative; *probatur* (*De sono*, LIV), followed by an *a.c.i.*; *confirmatur* (*De sono*, LX), followed by an *a.c.i.*; *non dubium est* (*De sono*, LIX), followed by a *quin*-clause; *cuius obvium est* (*De sono*, LXXX), followed by an *a.c.i.*; *in confesso est* (*De sono*, XLII; *De modis*, XCVI; *De tactu*, XIII [with *a.c.i.*]).

¹²⁸ Further examples are: *ratio est manifesta* (*De sono*, LXVIII); *idem ... satis manifestum est* (*De modis*, CXIIX); *quod adeo certum est* (*De sono*, LIV); *hoc multis modis probari potest* (*De modis*, CXI); *hoc etiam confirmabitur* (*De sono*, LXX); *experientia ipsa satis confirmat* (*De modis*, CIX); *clarius adhuc id constabit* (*De modis*, CXVI); *patet illud* (*De tactu*, XIV); *id quod ... clarissime patet* (*De tactu*, XVIII); *quod omnium clarissimum est* (*De sono*, LXX).

¹²⁹ Cf. Östlund 2000, pp. 74 f.

be settled at all. Most common is here the usage of some form of the verb *determinare*, but other constructions also occur:

- *facile non est determinare* (*De sono*, XXIV, LVI)
- *nemo practice possit hanc sonorum differentiam determinare* (*De modis*, CXVII)
- *vix quisquam est, qui determinare audet* (*De tactu*, V)
- *Est autem hic sonus in fistulis aliisque hujusmodi corporibus explicatu demonstratuque adeo abstrusus et intricatus, ut quid hic dicendum sit vix occurrat* (*De sono*, XXVIII)
- *Quod quidem singulis sonis certum definire nostri iudicii esse nequit* (*De tactu*, IV)¹³⁰

*Meta-textual constructions*¹³¹

Related to the abovementioned expressions on evidentiality are those in which the author states that a certain fact should be noted or acknowledged as true.¹³² In these we often meet impersonal constructions with a form in the gerundive, but sometimes also those with *licet*:

- *notandum est* [or *venit*¹³³] (*De sono*, VIII, X, XIX, LXXVI, LXXX; *De modis*, XCVIII, CVII)
- *sciendum est* [or *erit*] (*De sono*, III; *De tactu*, VII)
- *non putandum est* (*De sono*, XIV, XXII, LX, LXXI)
- *observandum est* (*De sono*, LXIV; *De modis*, XCVIII)
- *observare licet* (*De sono*, XXX, XL, LVIII; *De tactu*, VII)
- *invenire licet* (*De sono*, XXXIV)¹³⁴

Other very common expressions are those in which the author refers to matters that have been mentioned or treated previously in the same text, viz. ‘as was mentioned earlier/above’, and relates it to the present discussion. Also these occur in several different variants. First and foremost, we meet those created with a form of *dicere*, but then also with words such as *demonstrare*, *ostendere*, *monstrare*, *adducere*, *mentio*, and *explicare*, for instance:

¹³⁰ Further examples are: *neque hoc ab aliquo certo determinari posse existimo* (*De sono*, LVII); *ut illae omnes vix determinari possint* (*De sono*, LVIII); *ita ut vix aliquid certi determinari posse putem* (*De sono*, LXXVI); *ut potius vix ab ullo id rite determinari posse nobis persuadeamus* (*De tactu*, XVIII).

¹³¹ I.e. expressions in which the author directs the reader rather than informs them, or writes about the text itself rather than on the subject of the text. Cf. Östlund 2000, pp. 71 ff.

¹³² Cf. Östlund 2000, p. 73.

¹³³ The use of *venire* with the gerundive in deontic expressions of this kind is actually very common in scholarly and dissertational prose at the time (Helander, forthcoming [2]).

¹³⁴ Further examples are: *accipiendum est* (*De sono*, XXXV); *omnino est respiciendum* (*De tactu*, XIV); *non cogitandum est* (*De tactu*, IX); *animadvertendum est* (*De modis*, CXXI).

- *juxta jam ... dicta* (*De sono*, XII, LVII)
- *ut saepius dictum est* (*De Sono*, XXII, XLIV)
- *quod ... dictum est* (*De sono*, XXXI, XLIV, LX)
- *secundum ea quae ... dicta sunt* (*De sono*, XXXVI, XLV)
- *dictum est praeterea* (*De sono*, XXXVIII [twice])
- *satis jam dictum est* (*De sono*, LVIII, LXIII)
- *quod de Rythmo superius e Vossio diximus* (*De tactu*, XIX)
- *hisce ita demonstratis* (*De sono*, XX, XXXIV [his demonstratis])
- *eodem modo quo ... demonstratum est* (*De sono*, XXIX, XXXIII)
- *ut ostensum est* (*De sono*, LVIII)
- *ut antea ostendimus* (*De tactu*, XIII)
- *ut superius monstratum est* (*De tactu*, XI)
- *cujus causa haec omnia adducta sunt* (*De modis*, XCVIII)
- *mentio facta est* (*De sono*, LXXVIII; *De modis*, XCV)
- *cujus superius fecimus mentionem* (*De tactu*, VI)
- *prioribus, quos in aëre explicuimus* (*De sono*, XVII)¹³⁵

Similarly, the authors have some special ways of referring to the discussion itself, or even to the investigatory enterprise. Most important are those expressions with *agere*, and *considerare*, for instance:

- *de quo actum est* (*De sono*, LXI)
- *sed de soni generatione agere non est instituti nostri* (*De tactu*, II)
- *constitui hunc motum extra aures nostras solum considerare* (*De sono*, I)
- *in longitudine soni venit tempus considerandum* (*De sono*, LXVIII)
- *in considerationem [non] venit [or veniunt, or venire]* (*De sono*, XXVII, XXXIII)
- *ideoque et hic considerationem non mereri* (*De modis*, CX)
- *si circa soni considerationem paululum versemur* (*De tactu*, I)
- *Nobis prima tantum ... heic loci expendenda venit* (*De tactu*, VI)¹³⁶

¹³⁵ Further examples are: *eodem enim modo, quo jam ... dictum est* (*De sono*, XV); *ex quo ... dictum est* (*De sono*, XX); *ob causam modo dictam* (*De sono*, XXX); *modo dictum est* (*De sono*, XXXIX); *sicut ... dictum est* (*De sono*, XLIV); *ut jam dictum* (*De sono*, LVI); *etiamsi enim dictum sit prius* (*De sono*, LXIII); *ex his ... quae dicta jam sunt* (*De sono*, LVIII); *dicto jam modo* (*De sono*, LX); *juxta superius dicta* (*De sono*, LXXVIII); *dictum est hactenus* (*De sono*, LXVIII); *ex quibus, ut et ex iis quae in superioribus dicta sunt* (*De sono*, LXXXIII); *de quibus saepe dictum* (*De sono*, LXIX); *ut antea dictum est* (*De tactu*, XIII); *quam in Disputatione priori ... demonstravimus* (*De modis*, CXVI); *ut superius est ostensum* (*De tactu*, X)

¹³⁶ Further examples are: *praeterea, quia agi jam caeptum* (*De sono*, LIX); *de Modis praecipue agere constituimus* (*De modis*, CIV); *paulo accuratius hic sunt considerandi* (*De sono*, XI); *hic paulo exquisitius considerasse ... juvabit* (*De sono*, XVII); *si hanc ... considerare voluerimus* (*De modis*, CXIV); *si illos secundum latitudinem ... consideremus* (*De modis*, XXCIX); *vix enim quicquam ... occurrit consideratione dignum* (*De tactu*, III).

In the discourse the authors frequently state what they can show and treat, and aim at showing, and what they cannot treat, in the discussion that follows. We here meet constructions with verbs as *demonstrare*, *declarare*, *considerare*, *ostendere*, and *exponere*, for instance:

- *in sequentibus ulterius demonstrabimus* (*De modis*, CI)
- *tantum abest, ut ... demonstrare cogitemus* (*De tactu*, XVIII)
- *est ... explicatu demonstratuque adeo abstrusus et intricatus* (*De sono*, XXVIII)
- *in sequentibus ... nobis declarandum superest* (*De modis*, LXXXIV)
- *constitui hunc motum extra aures nostras solum considerare, et quomodo ... oriri possunt differentiae breviter ostendere* (*De sono*, I)
- *Haec omnia in ipsa Dissertatione, siquidem aliter fieri non potest, practice ostendere nitentur* (*De modis*, CXIIX)
- *quandoquidem causam tantum ... ostendere conemur* (*De tactu*, XVIII).
- *Restat jam ut ... exponam* (*De sono*, LXXI)¹³⁷

In the discussion, the authors are naturally forced to leave out many circumstances that are, although interesting, not really relevant in the present context, thus in the sense of ‘I omit mentioning ...’.¹³⁸ These expressions are most commonly construed with a form of *omittere*, but others occur as well:

- *brevitatis causa haec talia ex consulto jam omitto* (*De sono*, LXVI)
- *Quae plura ... dici possent ... consulto omittimus* (*De tactu*, VIII)
- *sed de soni generatione agere non est instituti nostri* (*De tactu*, II)
- *Quod notius est quam ut illud explicare opus sit* (*De sono*, XXX)
- *Ut enim ea ... silentio nunc praetereamus* (*De modis*, LXXXV)
- *Ut reliqua taceam intervalla* (*De modis*, XCIII)
- *Ulterius brevitatis causa nunc non extendimus* (*De modis*, XCVI)
- *Reliqua alio occasione reservamus* (*De modis*, CIV)
- *brevitatis causa nunc non repetimus* (*De modis*, CXVII)
- *Quo concesso certe ulterius hic quicquam non desideramus* (*De modis*, CXIX)
- *ut jam de eo ... nihil dicamus* (*De tactu*, IV)¹³⁹

¹³⁷ Further examples are: *in sequentibus demonstrare conabimur* (*De modis*, LXXXVII); *quia tamen existimo sonum ... posse demonstrari* (*De sono*, I); *quia hoc a nemine posse demonstrari* (*De sono*, II); *illum jam ulterius demonstrare instituti ratio non requirit* (*De sono*, VI); *ut nos heic sufficienter demonstrare cogitemus* (*De tactu*, XVIII).

¹³⁸ Cf. Östlund 2000, pp. 71 f.

¹³⁹ Further examples are: *consonantias autem compositas supra Octavam omitto* (*De sono*, LXXI); *itaque haec talia omnia consulto jam omitto* (*De sono*, LXXXIII); *ut reliqua omnia nunc omittamus* (*De modis*, CXIV).

Likewise, we meet instances in which the authors seemingly ponder upon the necessity of further investigations into a matter. This is expressed with the phrase *operae pretium*, which occurs at four instances:

- *omnia in subjecta materia calculo accurate subjicere, operae pretium non est* (*De sono*, IX)
- *omnia recensere operae pretium non est* (*De sono*, LVIII)
- *si circa soni considerationem paululum versemur, non defuturum operae pretium existimamus* (*De tactu*, I)
- *Quae si huc transferre animus esset, operae pretium non futurum existimamus* (*De tactu*, VIII)

The phrase is common in Classical Latin, as well as in scientific prose of the time of Vallerius.¹⁴⁰

Interaction

In previous studies on dissertational Latin prose, the interaction of the author with an imagined reader, often with the phrase *benevole lector*, as well as references to the praeses of the actual disputation, have been mentioned as highly typical of the genre.¹⁴¹ In our texts, we meet this element in *De tactu*:

- *Qui eam videre desiderat ... elegantissimam Amplissimi Praesidis nostri de Sono disputationem consulat* (*De tactu*, II)
- *Proinde quoties in hoc nostro scripto hae voces occurrunt, a consideratione corporis sic quidem abstractam Benevoli Lectoris cogitationem velimus, ut non nisi modum quendam illius secundum praecipuas suas differentias heic delineari existimet* (*De tactu*, III)

Expressions of 'according to'

Finally, a strikingly frequent phenomenon in our dissertations is the many occurrences of phrases expressing 'according to'. In this sense, we most often meet *secundum*+accusative (43 times) and *juxta*+accusative (24 times).¹⁴² Examples, here divided into 'according to a function' and 'according to a person's view', are:

- *secundum trinam dimensionem* (*De sono*, I)
- *secundum praecipuas suas differentias* (*De tactu*, III)
- *juxta soni velocitatem* (*De sono*, LXIV)
- *juxta cujusvis intervalli proportionem* (*De modis*, XCVI)

¹⁴⁰ Cf. Östlund 2000, pp. 72 f.

¹⁴¹ Östlund 2000, pp. 69 f., and Örneholm 2003, pp. 84 f.

¹⁴² Admittedly, the constructions with *pro*+ablative and *ad*+accusative belong to this category too in some cases.

- *secundum Gassendum (De sono, XIII)*
- *secundum artem Musicam (De modis, LXXXV)*
- *juxta superius demonstrata (De sono, XXII)*
- *juxta modum in th. 74 traditum (De sono, LXXIX)*

Rhetorical colouring

Considering what was said at the beginning of this section on style, regarding the generally decreasing importance of *inventio* in rhetoric at the time, the following account of rhetorical devices employed by the authors of our dissertations shall, with one exception (the *recusatio*), only deal with features belonging to the part of *elocutio*, i.e. figures and tropes. We shall focus below on some especially frequent and conspicuous examples. In spite of the fact that altogether we meet a considerable number of such devices in the texts, they all appear to be relatively rhetorically unadorned (*De sono* and *De modis* in particular). And some of the features, although they are generally accounted for under the label of rhetoric and treated in rhetorical handbooks, must be considered as pertaining to good Latin style in general rather than to deliberate rhetorical intention on the part of the author, especially since *imitatio* is the methodological keyword for acquisition of good style at the time.¹⁴³

Recusatio

Passages expressing the author's modesty, which is such a common rhetorical topos at the time,¹⁴⁴ occur in all of the main texts of the dissertations, not only in the peritexts:

- *Quia tamen existimo sonum cum omnibus suis differentiis ac causis per solum aëris motum satis clare et distincte posse demonstrari ... hujus rei experimentum quoddam pro viribus hic paucis faciendum putavi (De sono, I)*
- *Haec est illa, quam ego quidem excogitare potui, admirabilis hujus arcani ratio, quae si minus placuerit, meliorem certe magno cum desiderio exspectabo (De sono, XXXIX)*
- *De Soni natura, quatenus Physice considerantur, in Superioribus pro ingenio nostro breviter egimus (De modis, LXXXIV)*
- *Haec pauca illa fuere, quae circa considerationem Tactus Musicam instituto nostro viribusque ingenii admodum exiguis sufficere visa sunt. Levia quidem illa, et rei dignitati, ingenue fatemur, neutiquam respondentia (De tactu, XVI)*

¹⁴³ Cf. Benner & Tengström 1977, p. 89, and Örneholm 2003, p. 84.

¹⁴⁴ See Helander 2004, pp. 533 ff. For learned neo-Latin, cf. Benner & Tengström 1977, p. 93, and Örneholm 2003, p. 87.

- *Quapropter si tenuitatem nostram ausam esse poenituerit, certe voluisse bene opportuno ipsi solatio erit (De tactu, XVI)*

Hyperbaton

This figure, which means that related words are separated by some interposed word or words,¹⁴⁵ is probably the rhetorical feature that occurs most frequently in our texts. Some examples are:

- *ex ejus varietate variae sonorum secundum trinam dimensionem oriri possunt differentiae (De sono, I)*
- *tam varius est particularum illarum inter se motus ac situs (De sono, VII)*
- *objecta in variis a sonante distantiis posita (De sono, LXV)*
- *tanta sit inter Auctores dissentio (De modis, CXIII)*
- *pro varia particularum in corpore sonoro atque aeris dispositione et diversitate (De tactu, IV)*

Alliteratio

This figure is also very common in the dissertations, just as it was in both Latin prose and poetry in antiquity.¹⁴⁶ We often notice that the authors have deliberately adjusted the word order, in order to bring about the effect. Some examples are:

- *a loco priori progressae plurimos simul motus alios recipere ... possint (De sono, XIV)*
- *radii solares in corpora pellucida impingentes partim per poros se insinu-
ant, partim ... (De sono, LXIII)*
- *ad Instrumenta illa Polyplectra perficienda plurimae et variae praescribi
soleant (De modis, CXII)*
- *ex transpositione Melodiarum per Modos diversos satis manifestum est.
Musicis enim Practicis ... (De modis, CXIIX)*
- *Jucunda sane haec est consideratio, ubi consonantias in compositionibus et
cantibus quibuscunque (De tactu, VI)*
- *Diversorum in diversis hominibus humorum harmoniae varietate varie
commotorum ... alia est consideratio (De tactu, XVIII)*

Comparatio

Rhetorical comparisons,¹⁴⁷ where the similarities are either indicated with an *ut, sicut, instar, quaeamodum*, etc., or not indicated at all, occur in some places. Some examples are:

¹⁴⁵ Sz., pp. 689 ff., and Lausberg 1973, pp. 357 ff. Cf. Östlund 2000, pp. 67 f., and Örneholm 2003, pp. 82 f.

¹⁴⁶ Sz., pp. 700 ff.

¹⁴⁷ Cf. Lausberg 1973, pp. 285 ff.

- *variis particulis irregularibus admodum et ramosis ac instar plumularum varie flexibilibus* (*De sono*, V; repeated in *De tactu*, II)
- *Tales sunt flocci nivis, qui, quoniam instar lanae valde sunt molles et irregulares* (*De sono*, VIII)
- *Tali similitudine res videtur posse illustrari: sicut clavus ferreus per saepius iteratos parvos ictus in parietem facile trudi potest, ita sonus per debitam inflandi vim justus producit* (*De sono*, XXXVII)
- *sicut plures olivis vel aceto magis delectantur quam saccharo vel vino* (*De sono*, LXXVI)
- *quum tamen ejus causa non verius sit quam est aditus hominis in urbem causa quod pluatur* (*De modis*, LXXXVII)

Synonymia and hendiadyoin

At some instances we meet two or more words close to each other that are in the present context to be regarded as synonyms. In some cases they must rather be considered to be a *hendiadyoin*, i.e. as two words used for expressing one certain feature.¹⁴⁸ Some examples are:

- *rarefiunt et extenuantur* (*De sono*, VI)
- *explicatu demonstratuque* (*De sono*, XXVIII)
- *gratiores ac jucundiores* (*De sono*, LXXVI)
- *compositionibus et cantibus* (*De tactu*, VI)
- *res laetae atque jucundae* (*De tactu*, XIII)
- *figmentis et fabulosis narrationibus* (*De tactu*, XVII)
- *magis distincti ac observabiles* (*De sono*, LXX)
- *vis atque efficacia* (*De modis*, C, CXVI, CXIX; *De tactu*, XVI, XVII, XIX)

Litotes

Affirmative expressions in the form of negations of the contrary appear on several occasions.¹⁴⁹ Some examples are:

- *non nisi breviter* (*De sono*, XXVIII)
- *non tamen nego in nonnullis corporibus* (*De sono*, XXXI)
- *non potest non ... exprimere* (*De modis*, CIII)
- *Auditores non tantum non animadvertunt* (*De modis*, CXVII)
- *aquam et alios liquores subjectum ... esse non negemus* (*De tactu*, II)
- *non possit non perpetuo variari* (*De tactu*, IV)

¹⁴⁸ Sz., pp. 782 ff., and Lausberg 1973, pp. 329 ff. Cf. Östlund 2000, p. 68.

¹⁴⁹ Sz., pp. 777 ff., and Lausberg 1973, pp. 304 f. Cf. Östlund 2000, pp. 64 f., and Örneholm 2003, p. 82.

Polyptoton

The repetition of the same or related words or phrases in different case forms¹⁵⁰ is in our texts especially striking in *De tactu*:

- *quem gentes variae varium heic adhibent, aliquam Tactui varietatem non inferre* (*De tactu*, VII)
- *quae cantilenis diversis diversa praefigebantur* (*De tactu*, VIII)
- *Quanquam vero non sit in hujusmodi speciebus diversis diversa, sed prorsus eadem proportio ...* (*De tactu*, XI)
- *singulae Tactus partes singulos corporis motus* (*De tactu*, XII)
- *a variis varie addantur* (*De tactu*, XII)
- *Diversorum in diversis hominibus humorum* (*De tactu*, XVIII)

Gradatio

By this rhetorical device a saying is seemingly corrected by a following one, in order to strengthen the expression.¹⁵¹ In our texts it is at several times employed with *imo* / *immo*. Examples are:

- *Hinc est quod nec idem instrumentum in cunctis aedibus pro varia earundem structura, imo nec in eadem domo ...* (*De sono*, LVIII)
- *aliasque innumeras conditiones varia dispositione, alios, imo contrarios prorsus, effectus producere* (*De modis*, LXXXV)
- *Quoniam non solum perfectum Musicum illud requirit, sed ingeniorum, quae singulis hominibus sunt, plenam notitiam studiorumque in uno et eodem homine diversis temporibus diversorum cognitionem, immo, quorum singulis momentis varia vis ac potestas est, affectuum perpetuam observationem postulat* (*De tactu*, X)

Rhetorical questions

Once in *De sono*, and at some places in *De tactu* we meet rhetorical questions:¹⁵²

- *Quae vibrationes exacte faciunt sonum unisonum cum fistula organica octupedali, seu cum tubo aperto 8 pedum, adeo ut nervus tam laxus vel crassus, ut spatio secundi 16 duntaxat recursus faciat, vix auditum distincte feriat, ut de illo iudicare quis possit?* (*De sono*, XXIV)
- *Quam enim difficilis foret cantus, si uni notulae 5 aut 7 aequales opponeremus? Et quis quaesumus harum distinctionem accuratam auditu percipere posset?* (*De tactu*, IX)

¹⁵⁰ Sz., pp. 707 f., and Lausberg 1973, pp. 325 ff.

¹⁵¹ Lausberg 1973, pp. 315 ff.

¹⁵² Sz., p. 467, and Örneholm 2003, p. 84.

- *Quarum primam illam sex quartarum speciem non aliud quam duplicatam Hemiolam esse quis non videt? Aut ei prorsus similem alteram illam sex octavas complexam non aestimat? (De tactu, XIII)*
- *Quid enim frequentius quam in operibus, quae hodie prodeunt, Musicis Tactum Spondaicum numero binario significare? (De tactu, XV)*

1.5.3 Comparison of Language and Style

It has been claimed several times above that there are obvious divergences to be noticed between *De sono* and *De modis* on the one hand, and *De tactu* on the other, as far as language and style are concerned. In this section we shall therefore summarize the differences that have been visible in the earlier treatment, primarily by stressing in what way *De tactu* stands apart from the other two dissertations. It is true that a comparison of this kind could have been expanded by the inclusion of other texts written by Vallerius and Retzelius, in order to establish their individual styles more firmly, but for the present purpose it is in fact enough only to state that there are different authors. Other circumstances point out who these authors are in each case.

Notably, we saw in the section on orthography that some spellings only occurred in *De tactu*, while others were found in *De sono* and *De modis*. In the latter we consistently found *caeterus*, whereas in *De tactu* it is *ceterus*. In *De tactu* we meet the spelling *immo*, while the other two have *imo*. In *De tactu* we never find *quum* for the conjunction *cum*, while in the other two we find it 14 times. Likewise, *De tactu* generally has the spelling *heic* (adverb), while the other two have *hic*. The differences in orthographical respects are thus perhaps rather few, but nevertheless both striking and considerable.

In morphological respects, two features stand out in particular. In *De tactu* we never find the strengthening *-met* attached to *ipse*, while in *De sono* and *De modis* this is attested four times. In *De tactu* the deictic suffix *-ce* is also used with more kinds of inflected forms of the pronoun *hic*, *haec*, *hoc*. While the other two only have two variants (*hisce* and *hosce*), *De tactu* has five (*hicce*, *hocce*, *hujuscemodi*, *hasce* and *hisce*).

From the syntactical section above, we can see that in *De tactu* there are no instances of the shifted perfect passive, which is so common in other dissertations of the time, while there are a few instances in the other two.

From the vocabulary section above, no conclusions can be drawn on the authorship from the different characteristics of the vocabulary in the dissertations. The small differences that can be noticed, e.g. that there are as many vernacular terms in *De tactu* as in the other two together, could certainly depend more on the different subjects than on different authors.

Further investigations into the stylistic characteristics show that there are also important differences to notice in this respect. From the first section of *characteristic jargon* above, viz. that on 'key words and phrases', we can see that *De tactu* lacks most of those phrases, which occur in considerable num-

ber in *De sono* and *De modis*, as well is in the general scientific discourse of the time. All of the phrases *ita in reliquis*, *nec [nihil] obstat quod [quo minus]*, *caeteris paribus*, *caeteris positis*, *his positis*, *quantum in se / ipsis est*, *simul sumpti* [-ae, -a] and *quod ad ... pertinet* are missing in *De tactu*, while *ut voca[n]t* occurs there once, in comparison to five times in *De modis*.

From the section ‘constructions and expressions of causes and effects’ we notice that the typical constructions usually occur in all three texts. In *De tactu* they are somewhat fewer, and this points to a certain different tendency. The circumstances are similar for the sections dealing with ‘modifying expressions’ and ‘meta-textual constructions’. We notice that the expression *manifestum est* [evadit] occurs only in *De tactu*, while *facile apparet* and *notum* [notissimum, notius] *est* can only be found in *De sono* and *De modis*; the other expressions occur in all of them, although generally to a lesser extent in *De tactu*.

In the last two sections of *characteristic jargon* above, however, there are important differences to be noticed. In *De tactu* there are occurrences of an interaction of the author with both reader and praeses which is typical of the genre, while this cannot be found at all in the other two texts. Even more striking is the fact that the very frequent usage of *secundum* and *iuxta* in the sense of ‘according to’ is almost exclusively present in *De sono* and *De modis*. We meet *secundum*+accusative in this sense 21 times in *De sono*, 20 times in *De modis*, but only twice in *De tactu* (one of which is in a quotation from Mersenne). The formula *iuxta*+accusative in this sense occurs 18 times in *De sono*, six times in *De modis*, but not at all in *De tactu*. Often it is used either for referring to statements made earlier in the discussion, or to a specific thesis.

Finally, some divergences that can be noticed as far as the rhetorical colouring is concerned should be mentioned. For there are in fact, as we can see above, two rhetorical devices that almost exclusively occur in *De tactu*, viz. the rhetorical question and the polyptoton, while many of the others can be found in all three dissertations.

Concluding reflexions

Summarizing and comparing how the three dissertations differ in language and style, as their characteristic features were accounted for in the earlier treatment, we can safely establish that there are notable divergences. Why would one and the same author suddenly stop using certain spellings, expressions or constructions, if these have been generally employed earlier? Why would, for instance, an author suddenly start spelling the adverb *hic* as *heic*, if he has not done so previously, the same holding true for *caeterus* / *ceterus*, *imo* / *immo*, and *quum* / *cum*? And why would this author almost completely stop using the constructions of *secundum* and *juxta*, which had proved to be so useful before? When asking these questions we should be aware of the fact that this comparison has not explicitly included, for

instance, aspects such as sentence structure and period building, although the less frequent usage of certain constructions reported above gives a clear indication. As the reader will notice, there are also notable differences between the texts in this respect. In short, we can nevertheless say that the first two dissertations, *De sono* and *De modis*, display a greater striving for *perspicuitas*, and this will explain the more frequent usage of some set phrases, constructions and expressions, which were clear and well-established in scientific discourse at the time, albeit artless and empty of rhetorical adornment.

Together with the circumstances that were reported in section 1.4 above, these differences make it certain, I claim, that there was a different person holding the pencil in *De tactu* from in *De sono* and *De modis*. And in accordance with that discussion we must presume that Harald Vallerius wrote *De sono* and *De modis*, once as the respondent and once as the praeses, while the respondent Olaus Retzelius wrote *De tactu*.

1.6 Editorial Principles

The Latin texts in the present edition have been established from the copies of the three dissertations stored at Uppsala University Library, under the shelfmarks *Diss. Ups. Praes. Norcopensis* I (*De sono*), *Diss. Ups. Praes. H. Vallerius* I (*De modis*), and *Diss. Ups. Praes. H. Vallerius* 3 (*De tactu*). In some cases, when peculiarities in the text have made it necessary, these have been compared with the copies of the three dissertations stored at the Royal Library (Stockholm), under the shelfmarks *Diss. Ups. Norcopensis* 4:o (*De sono*), *Diss. Ups. Wallerius* 1681–1711 4:o (*De sono* and *De modis*), and *Diss. Ups. Wallerius* 1697–1699 8:o (*De tactu*), as well as the copy of the *De sono* dissertation stored at the Diocese Library in Skara, and the copies of the three dissertations stored at Södertörn University Library, which still lack shelf marks.

The following principles have been used for the presentation of the texts in this edition:

Very obvious misprints are corrected without remark. This is the case for confusions between *b* and *q*, and *u* and *n*, of spacing errors, as well as occasional mistakes such as *remotiores* for *remotiores* (*De sono*, thesis XIX, 5). Other kinds of corrections are accounted for according to each published title last in this chapter.

Spelling has otherwise been generally retained, with the exception of *u* and *v*, which have been normalized according to our most common modern orthography.

All kinds of diacritical marks have been deleted, with the exception of diaeresis, which is still helpful to modern readers.

Abbreviations have generally been expanded without remark, with the exception of frequently occurring and easily understood examples such as *th.* for *thesis* (though not in headings), *n.* for *numerus*, *prop.* for *propositio*, *sect.* for *sectio*, *cap.* for *capitulum* and *lib.* or only *l.* for *liber*, which are kept as they were written in the original text. Nor are abbreviated first names expanded. The expansions include, for instance, the *linea nasalis* over the final vowel in *notu[m]* (*De sono*, thesis XIX, 4), as well as every instance of the enclitic *-q*; which has been expanded to *-que*. In the printed text *et* is written with an ampersand, but this has been altered to *et*. The ligatures *æ* and *œ* are written as *ae* and *oe*, while *β* is written as *ss*.

Punctuation has been altered to conform to modern standards, as Renaissance practice in this field is often confusing to modern readers quite generally. In printed texts the compositor may also have been responsible for many of the peculiarities.

Capital letters have generally been retained, except when changes in punctuation have been made. These are also added for the titles of works by other authors. In accordance with the practice in Renaissance prints, capital letters are normally used in order to lend extra emphasis to the word in question and are therefore of interest to us. The same is the case with any original italics. These are also retained, for the same reason, with the exception of the main text of the congratulatory address to Vallerius by Andreas Norcopensis in *De sono*, where italics and ordinary types have been inverted. Italics are also added in this edition for names of works by other authors that are mentioned in the text, as well as for the words in the original text that are set with German types.

Given below is an account of the few alterations made for the text of this edition, many but not all of which can also be found as similar handwritten corrections in the printed dissertations themselves (some of them may have been made at the printing house). The text written after the lemma is the reading found in the original print, while the text written in front of it is the reading belonging to this edition.

De Sono:

I: *variae sonorum ... differentiae]* *varij sonorum ... differentiae*; XII, 2: *hi aquae circuli]* *hae aquae circuli* XV, 4: *Ecnephias]* *Enephias*; XXIX: *ut est B]* *ut est D*; XXXV: *compensetur]* *compensitur*; XXXIX: *frangatur]* *tangatur*; XLIIIX: *aequalia]* *aequa*; LXIII: *trabs]* *trabe*; LXVIII: *sesquialtera]* *sequialtera*; LXXX: *tensa]* *tonsa*

De Modis:

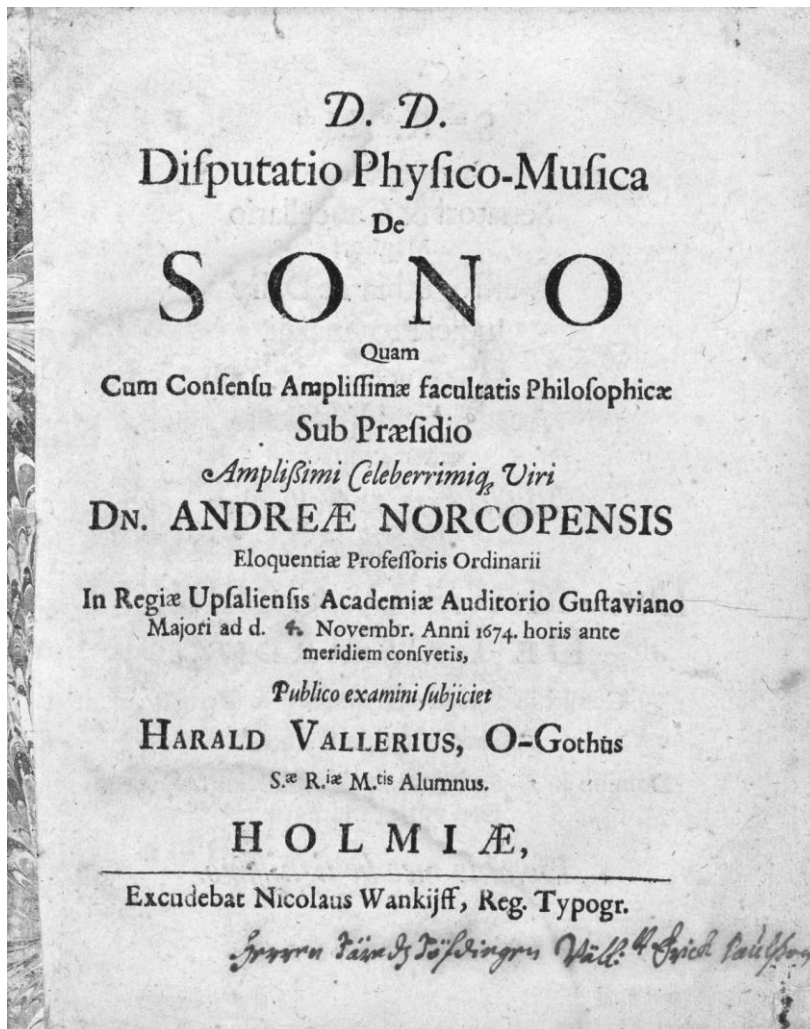
LXXXVII: *hisce]* *hise*; XCIX: *moestitiae]* *modestiae*; *subtristis]* *subtristis*; CXVI: *alio]* *alii*

De Tactu:

title: M. DC. XCVIII.] M. DC. LXCVIII.; VII: secundum horae minutum]
secundum hora minutum; XVII: verbis] vebis; τρόπος] τρόφος; gratulatio 2:
HALLENBERG] HALLONBERG

2 Disputatio physico-musica de sono

2.1 Text and Translation



Deo Duce.

Disputatio Physico-Musica
De
SONO,
Quam,
Cum Consensu Amplissimae facultatis Philosophicae,
Sub Praesidio
Amplissimi Celeberrimique Viri
Domini ANDREAE NORCOPENSIS,
Eloquentiae Professoris Ordinarii,
In Regiae Upsaliensis Academiae Auditorio Gustaviano
Majori ad diem [4] Novembris Anni 1674 horis ante
meridiem consuetis,
Publico examini subjiciet
HARALD VALLERIUS Ostro-Gothus,
Sacrae Regiae Maiestatis Alumnus.

HOLMIAE,
Excudebat Nicolaus Wankijff, Regius Typographus.

Under the guidance of God.

A physico-musical disputation
on sound,
which,
with the consent of the most renowned philosophical faculty,
under the presidency of
the most renowned and illustrious man
Lord Andreas Norcopensis,
professor ordinarius of eloquence,
in the *Auditorium Gustavianum majus* at the Royal Academy of Uppsala
4 November 1674 at the usual time *ante meridiem*,
Harald Vallerius from Östergötland,
holder of his Holy Royal Majesty's scholarship,
shall subject to public examination.

In Stockholm,
produced by Nicolaus Wankijff, Royal printer.

Sacrae Regiae Maiestatis
Regnique Sueciae
Senatori et Cancellario
Magno,
Vestrogothiae ac Daliae
Judici Provinciali,
ut et
Academiae Upsaliensis
Cancellario,
Illustrissimo ac Celsissimo
Domino,
Domino MAGNO GABRIELI
DE LA GARDIE,
Comiti in *Läckö, Arensburg et Pernou,*
Libero Baroni in *Eekholm,*
Domino in *Hapsal, Magnushoff, Helmet, Höyen-*
torp och Wennegarn,
Domino meo benignissimo.

To the great
Councillor and Chancellor
of his Holy Royal Majesty
and the Kingdom of Sweden,
chief district judge
of Västergötland and Dalsland,
as well as
Chancellor
of the Academy of Uppsala,
the most illustrious and distinguished Lord,
Magnus Gabriel
De la Gardie,
Count of Läckö, Arensburg and Pernau,
Baron of Ekholm,
Lord of Hapsal, Magnushof, Helmet, Höjen-
torp and Venngarn,
my most benignant patron.

*Illustrissime Comes,
Domine Gratosissime.*

Nisi praeter singularem illam Excellentiae Tuae gratiam benevolentiamque, qua omnes bonarum literarum cultores semper clementerque excipere soles, etiam favorem Tuum erga Musices Studiosos longe rarissimum ipsemet satis exploratum haberem, Excellentissimo Tuo Nomini, pluribus majoribusque Patriae negotiis quam ego unquam vel cogitare possim occupato, vile hoc exercitium inscribere nunquam auderem. His vero documentis quammaxime fretus, ut velit Excellentia Tua hoc quaecunque specimen ad pedes Tuos summa mentis veneratione depositum vultu benevolo ac sereno suscipere, perquam humillime oro et obtestor

Excellentissimi Tui Nominis

Devotissimus cliens
Harald Vallerius.

Most illustrious Count,
most gracious Lord.

If I myself was not certain enough of, besides Your Excellency's outstanding grace and benevolence, by which you always gently give shelter to all practicians of scholarship, also your most remarkable favour towards students of music, I would never dare to dedicate this simple exercise to your excellent name, which is occupied with more and greater affairs that concern the fatherland than I could even ever imagine. But relying very much upon these proven facts, I pray and entreat very humbly, that Your Excellency with a benevolent and serene gaze would like to take up this specimen, of whatever quality it is, which I have laid down at your feet with my heart's utmost reverence.

Your highly excellent name's

Most devoted client
Harald Vallerius.

Ad juvenem
Literis et moribus cultissimum
Dominum HARALDUM VALLERIUM
De sono perite Philosophantem.

Si verba Philosophi ψοφητικὸν μὲν οὖν τὸ κινητικὸν ἐνὸς ἀέρος συνεχεῖα μέχρις ἀκοῆς apud omnes eos, qui sibi nomen de celebri Peripato sumpserunt, peraeque valuissent, definitionem illius doctissimam ὁ ψόφος ἐστὶ κίνησις τοῦ δυναμένου κινεῖσθαι τὸν τρόπον τοῦτον, ὥνπερ τὰ ἀφαλλόμενα ἀπὸ τῶν λείων, ὅταν τις κρούσῃ tanto temporis spatio in Scholis nequitquam obruisset obnubilassetque *qualitas audibilis*. Atqui sive quod non esset cujusvis hunc ipsum motum suis modis rationibusque definire, sive quod dignitati philosophantium parum consulturi viderentur, quicunque rem suapte natura intricatam verbis itidem et amplius obscurare nollent vel nescirent, accidit profecto, ut in Philosophia de sono res definienda definitione ipsa multo esset clarior illustriorque. Philosophum quidem ipsum in argumento praesenti parum aut nihil fugisse satis constat, quo nomine etiam a magna parte sectatorum suorum longissime recedit. Attamen non exiguam illi lucem ab ingenio observationibusque temporum horum in dies accedere, cum ratione negaverit nemo. In eo genere habemus, humanissime *VALLERI*, industriae tuae specimen cum rerum varietate jucundum tum etiam diligentia tua satis insigne, unde non tantum quid profeceris colligere, sed etiam quid olim pollicearis ominari licet. Sit tibi semper idem, qui ante hac fuit animus, eadem in Musarum cultu pertinacia et mores numquam sequiores. Equidem tui similium nemini culmen, quo niteris, inaccessum fuit. In rebus autem omnibus ut Numine utaris propitio, vehementer nunc optat

Tui Amantissimus
Andreas Norcopensis.

To the young man
Harald Vallerius,
most educated in letters and manners,
when he philosophizes skilfully on sound.

If the philosopher's words 'that, then, is resonant which is capable of exciting motion in a mass of air continuously one as far as the ear'¹⁵³ had been quite equally important for all of those who have taken their name from the famous Peripatetic school, the *qualitas audibilis* would with so much time spent in schools by no means have eclipsed and obscured his most learned definition 'sound is motion of that which is capable of being moved in the same manner as things rebound from smooth surfaces when struck sharply against them'.¹⁵⁴ But either since it was not the task of anybody whosoever to define this motion according to its modes and principles, or since they seemed to care too little about the dignity of the philosophers, whoever in like manner did not want to or know how to further obscure with words a question that is intricate by its own nature, it actually happened to be so, that in the philosophy on sound the thing to be defined was much clearer and more evident than the definition itself. In the present argument it is very obvious that little or nothing has escaped the Philosopher himself. In this respect he also differs very much from a great portion of his followers. That not a small light has nevertheless been added to him day by day through the cleverness and observations of this time, nobody can deny with reason. We have of this kind, the most cultured Vallerius, a specimen of your industry that is both pleasing by the variety of ideas, and very distinguished by your diligence. From this it is possible not only to gather what you have achieved, but also to predict what you promise hereafter. May you always have the same spirit as you have had so far, the same pertinacity in your worship of the Muses and unchanging manners. Indeed the peak, towards which you struggle, has been inaccessible for none of those who are similar to you. That you may experience God propitious in all circumstances, now intensely wishes

Your dearest friend
Andreas Norcopensis.

¹⁵³ Translation by R. D. Hicks in *Aristotle. De Anima. With Translation, Introduction and Notes* (1965), p. 85.

¹⁵⁴ *Ibid.*, p. 87.

Thesis I.

Per sonum intelligo sensationem illam, quam mens nostra ex motu quodam tremulo aëris per aures percipit. Si quis voluerit sonum ut accidens quoddam reale extra motum, quem dixi, aëris tremulum et sensum nostrum considerare, sicut hactenus Philosophi communiter consueverunt, non repugnabo. Quia tamen existimo sonum cum omnibus suis differentiis ac causis per solum aëris motum satis clare et distincte posse demonstrari, videoque hoc idem a praestantissimis hujus aevi Philosophis certo affirmari, hujus rei experimentum quoddam pro viribus hic paucis faciendum putavi. Itaque relicta illa controversia constitui hunc motum extra aures nostras solum considerare, et quomodo ex ejus varietate variae sonorum secundum trinam dimensionem oriri possunt differentiae breviter ostendere. Quamvis autem sonum extra aures tantum ut motum considerem, quia tamen longo jam usu receptum est illum motum etiam sonum appellare, vocabula haec in sequentibus indifferenter usurpabo.

II.

Non autem est animus de mente disserere, quomodo possit illa ex variis motibus pro varietate organorum modis quamplurimis affici, et per species sentire, quia hoc a nemine posse demonstrari nec unquam ab ullo ostensum esse arbitror. His itaque missis suppono mentem tali natura praeditam esse, ut possit secundum varios motus varie a corporibus pati, et vicissim per organa in corpus agere.

III.

Nec jam institui organorum constitutionem, per quae mens sonum sentit, ex Anatomia petitam exponere, nec quomodo illa organa in diversis animantium generibus numero ac collocatione variant declarare, nec quodnam singularum sit partium officium vel necessitas ostendere. Sed saltem sciendum erit eam omnium organorum fabricam ac dispositionem esse, ut motum quemcunque sonorum, quem in se recipiunt, eodem modo eademque ratione menti quoque repraesentent.

IV.

Dixi sensationem illam oriri ex motu aëris, adeoque aërem esse proprium soni subjectum, per quod ad aures nostras defertur. Quod omnes facile concessuros puto, si modo considerent quam variis modis sonus pro varia

Under the guidance of God.

Thesis 1.

By sound I understand that sensation, which our mind perceives with the ears from a certain trembling motion of the air. If anyone wants to consider sound as some kind of *accidens reale* outside of, as I said, the trembling motion of air and our sense, just as the philosophers have commonly done so far, I shall not object to that. But since I am of the opinion that sound with all its different characteristics and causes can be explained clearly and distinctly enough through the motion of air alone, and since I notice that the same thing is certainly asserted by the foremost philosophers of our time, I thought that some kind of experiment into this matter should be carried out, in proportion to my poor abilities. Having thus disregarded this controversy, I decided to consider only the sound outside our ears, and to shortly show how different variants of sound can come about from its variety, in accordance with its threefold dimension. Even though I consider sound outside the ears merely as motion, since it has been accepted through long usage to also call this motion sound, I shall use these designations interchangeably in the following.

2.

However, it is not my intention to discuss the mind, how this can be affected in very many ways from different motions in accordance with the variety of the organs, and perceive through outward appearances, since I think that this cannot be explained by anybody and that it has never been demonstrated by anyone. Having therefore passed over these things, I assume that the mind is endowed with such a nature, that it can experience differently from bodies according to their different motions, and in turn act through the organs into the body.

3.

I have neither set about to describe the constitution of the organs, with which the mind perceives sound, with the aid of anatomy, nor to demonstrate how these organs differ in number and position in different kinds of living beings, nor to show what the function or necessary duty of each single part is. But one must at least know that the construction and arrangement of all organs is such that they also present every sounding motion, which they receive in themselves, to the mind in the same way and according to the same principle.

4.

I said that this sensation comes about from the motion of air, and also that air is the characteristic subject of sound, by which it is brought to our ears. I think that everyone will easily admit this, if they would only consider

constitutione aëris semper mutetur. Quamvis autem non negem posse etiam sonum et in materia quadam subtiliori, ut est aether, etc., et in medio crassiori, ut est aqua, lac, oleum, et in aliis liquoribus, proportionaliter ad medii densitatem commode fieri, quia tamen nos rerum qualitates ex nostris sensibus dimetiri solemus, mediaque haec reliqua nostris organis ita non sunt proportionata ac est ipse aër, et nec aliud medium magis accommodatum forsán datur, nec quemquam adhuc admodum hoc negasse cognovi, eam ob causam aërem soni subjectum proximum esse affirmare non dubitavi.

V.

Intelligo autem per aërem corpus illud terram proxime in magnam altitudinem ambiens (Atmosfera terrae alias dictum), quod variis particulis irregularibus admodum et ramosis ac instar plumularum varie flexibilibus celerrimeque hinc illinc motis constat. Quod autem sint in aëre variae particulae facile concedi existimo, si modo consideremus quam variae exhalationes et vapores ex terra et aqua aliisque corporibus sursum continuo cogantur, quamque varia meteora, ut etiam animalia, hinc quotidie generentur. Quoniam ergo hae omnes particulae in altum elevatae cum reliquis omnibus ibi uniuntur, et in eundem cum illis motum conspirant unumque corpus fluidum ibi componunt, totum hoc compositum nomine aëris comprehendo. Quia praeterea nemo cum ratione asseruerit omnes istas particulas vel aequales esse magnitudine et mole, vel etiam angulos illarum varijs modis flecti non posse, cum praesertim vacuum non detur debeantque omnia spatia materia aliqua repleri, nihil utique obstat, quo minus eas et magnitudine ac mole esse prorsus inaequales et modis longe diversissimis inflecti posse dicamus. Quia denique figura earum vel per flexuras vel alium quemcunque modum continenter variatur, non potest non illa esse admodum irregularis. Notum autem est quam varias corporum irregularium figuras statuunt Geometrae, quarum tamen nulla vel fingi potest, quam unaquaeque harum particularum in sese aliquando recipere non possit, adeo ut illarum figuram indefinite variam esse tuto statuamus.

VI.

Ulterius, quia totum harum particularum compositum corpus quoddam fluidum simul componit, necessum est ut hae particulae vario ac vago inter sese motu in omnes partes moveantur. Hunc motum quamvis ob particularum exiguitatem nimiam sensu non advertamus, illum tamen ex effectibus fluidi, ut ex coctionibus, putrefactionibus, mixtionibus, solutionibus, corruptionibus aliisque operationibus facile colligere possumus. Hi enim omnes effectus sine motu vario particularum ne quidem

in how different ways sound always changes depending on the varying constitution of the air. But although I do not deny that sound can also come about without difficulty both in some kind of finer substance, such as ether, etc., and in a thicker medium, such as water, milk, oil, and in other liquids, in proportion to the density of the medium, however, since we usually measure out the quality of things with our senses, and these other media are not so proportioned to our organs as the air, and neither is there perhaps another more suitable medium, nor do I know of anyone so far who has denied exactly this, for this reason I did not hesitate to assert that air is the subject closest to sound.

5.

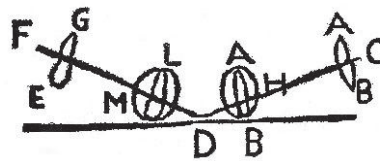
With air I understand the body that encircles the earth closely up to a great altitude (at other times it is called the earth's atmosphere), which consists of various very irregular and branch-like particles that just like small feathers are pliable in different degrees and move very rapidly here and there. I think it can be easily agreed upon that there are various particles in the air, if only we consider how various exhalations and vapours are continuously forced upwards from the earth and the water and from other bodies, and how various aerial phenomena are every day generated hereby, just as living beings are. Accordingly, since all these particles that are lifted up to the sky are there united with all others, and act together with these into the same motion and there make up one fluid body, I refer to all this that has been made up under the designation of air. Moreover, since nobody has asserted with reason that all these particles are either equal in size and weight, or even that their angles cannot be curved in different ways, especially as vacuum is not permitted and all spaces must be filled with some substance, nothing at all prevents us from saying that they are quite unequal both in size and weight, and that they can be curved in very different ways. Since finally their shape varies repeatedly, either in curves or in some other way of any kind, this cannot but be very irregular. It is well-known how many various figures geometricians state that there are in irregular bodies. Nevertheless none of these figures can even be imagined, which each one of these particles could not adopt at any time. Therefore we can safely establish that their shape is endlessly various.

6.

Furthermore, since all that has been made up by these particles at the same time makes up some kind of fluid body, these particles necessarily move in all directions in relation to each other in a varying and inconstant motion. Although we do not notice this motion with our senses because of the exceedingly small nature of the particles, we can easily get hold of it from the effects of the fluid, as from concoctions, putrefactions, mixtures, solutions, corruptions and other operations. For all these effects cannot even

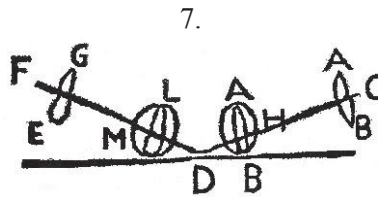
concupi possunt (sed illum jam ulterius demonstrare instituti ratio non requirit). Motus hujus fluiditatis varii esse possunt gradus, vel prout particulae aërae magis aut minus agitantur, vel prout majores vel minores sunt. Sic aërem comperimus fluidiorem esse aestate quam hyeme, die quam nocte, meridie quam vespere, coelo sereno quam nebuloso, locis sublimioribus quam depressioribus, etc. Ita noctu, ut et mane ac vespere, ubi calor minuitur, vapores minus agitati magis magisque gradatim condensantur ac in moles majores conglobantur. Quod idem quoque temporibus quibus pluit, ut et paulo post, necessum est fieri, quia plures adhuc vapores in aëre haerent, ut ex iride constat. Contra vero die, ubi calor magis intenditur, eadem particulae sensim magis magisque rarefiunt et extenuantur.

VII.



Praeterea, quum ita particulae aëris inter sese moveantur variisque singulae sint figuris praeditae, quocunque demum modo eas sibi invicem occurrere supposuerimus, pro vario tamen ad invicem situ, motu ac figura, singulae quoque ad se circa proprium axem movendas continuo disponentur, ut exempli gratia moveatur particula AB a C versus corpus D per lineam CD. Primo impinget in corpus D uno sui puncto B. Quod punctum, quia ulterius per lineam rectam pergere non potest, statim sursum versus HA reflectetur, dum interim punctum A perget versus D, atque ita motu circulari parvam sphaerulam BHAD conficiet. Eadem est ratio cum corpore EG per lineam FD. Statim enim ac perveniet ad D, incipiet circumvolvi per DML, atque ita in reliquis. Nec obstat quod possint particulae AB et EG perpendiculariter vel situ parallelo cum corpore D in illud impingere, atque ita eodem situ exinde reflecti, quia tam varius est particularum illarum inter se motus ac situs, ut si non in unam, tamen in aliam oblique incidant. Et praeterea potest et corpus D valde irregulare esse, quod tamen hic planum supponitur. Itaque quocunque modo particulae moveri supponantur, quamvis non semper tantum spatium ipsis concedatur ut actu circumgyrentur, tamen ad gyrandi conatum circa proprium axem per varium contactum continuo impellentur.

be conceived of without a varying motion of the particles (but the plan of my purposed undertaking does not require any further proof of this). The motions of this fluidity can be of different degrees, according to whether the aerial particles are more or less agitated, or as they are greater or smaller. Thus we find that the air is more fluid in the summer than in the winter, more in the day than in the night, more at noon than in the evening, more under a clear sky than under a cloudy, more in loftier places than in lower ones, etc. Therefore at night, as well as in the morning and evening, when heat is reduced, less-agitated vapours gradually get more and more condensed and conglobate into greater masses. Necessarily the same thing happens also when it rains, as well as shortly afterwards, since more vapours still remain in the air, which is evident from the rainbow. But on the contrary the same particles slowly rarefy and diminish more and more in the day, when the heat is more intensified.



Moreover, although the particles of air move in this manner in relation to each other and are all provided with different shapes, in whatever way we finally assume that these run into one another, all of them are also continuously disposed to move themselves around their own axis, in accordance with their different mutual positions, motions and shapes. Therefore the particle AB, for example, moves from C towards the body D along the line CD. First it strikes into the body D with its one point B. This point is immediately turned back up towards HA, since it cannot proceed any further along a straight line. Meanwhile the point A proceeds towards D, and thus brings about the small sphere BHAD in a circular motion. The same is the principle for the body EG along the line FD. For as soon as it reaches D, it begins to revolve along DML, and likewise in other cases. That does not prevent that the particles AB and EG, vertically or from a place parallel with the body D, can strike into this, and thus be turned back from that same place, since the motion and position of these particles is so different in relation to each other, that they fall, if not into one, nevertheless indirectly into another one. In addition also the body D can be very irregular, but here it is assumed to be flat. Therefore, in whatever way the particles are assumed to move, although not always so much space is granted to them that they go around in circles because of the impulse, they are continuously impelled to attempt circling around their own axis because of the different touches.

VIII.

Quum particulae aëreae hinc inde agitatae singulae hoc modo parvas quasdam sphaerulas describunt vel describere conantur, necessario majus spatium quaerunt, ita ut omnes particulas alias intra sphaerulas illas contentas aut a sese expellant, aut etiam una secum circumgyrent. Praeterea iterum ex alia causa externa possunt particulae in ipsa agitatione condensari, in condensatione vero sphaerulas illas nequeunt ita libere vel integras absolvere. Et quia per th. 5 varie sunt flexiles, facile etiam possunt ramulos suos paulatim inflectere. Quia vero ea est plerarumque rerum natura, ut dum per condensationem vel alium quemcunque motum flectuntur, statim conentur sese in statum priorem reducere, ut et quia adhuc eadem vis motus externa manere potest illaeque arctius condensatae sunt quam ut sphaerulas suas libere expediant, fit hinc ut omnes magno molimine ac vehementia sine mora ab invicem recedere et in majus spatium se diffundere nitantur. Praeter alia innumera hujus rei experimenta, quam-maxime clarum est hoc ex sclopetis aëre onustis, in quibus aër condensatus tanto impetu erumpit ut dici vix possit. Hic tamen de ramosis particulis notandum est, quod si praeter motum hunc fluiditatis nimis sint flexiles ac molles, motum omnem in se sistent nec ad situm priorem se reducere poterunt, eadem ratione qua globulos in mensa nuda multo longius ac commodius moveri cernimus quam in mensa tegmine superstrata, et pilam in lutum missam non reperiunt sed ingredi, contra vero in parietem projectam reflecti, atque ita in reliquis. Tales sunt flocci nivis, qui, quoniam instar lanae valde sunt molles et irregulares, omnem motus vim fere sistere possunt.

IX.

Denique notum est corpora, quae ita moventur ut alia aliis occurrant, varie suum motum inter sese communicare pro ratione internae molis celeritatis et determinationis. Insuper videmus etiam corpus, quod majorem habet quantitatem intrinsecam, difficilius quidem moveri posse quam aliud magnitudine ipsi aequale sed mole minus, hoc est ab alia materia magis porosa compositum. Illud tamen diutius suam vim retinebit quam hoc, quia majorem in sese motum ratione molis internae recipere potuit. Ut globus plumbeus difficilius quidem ad motum excitatur quam ligneus ipsi magnitudine aequalis etc., ille tamen et multo majorem motus quantitatem in se recipiet et multo diutius illum retinebit quam hic. Si enim adsit vis proportionata et sufficienter movens, illa plumbeum longius quam ligneum globum a se projicere poterit. Ita fit in omnibus corporibus servata

8.

When the particles of air that are agitated here and there each of them in this way describes or tries to describe some kind of small spheres, they necessarily require a greater space, so that they either eject from themselves all other particles that are contained within these small spheres, or rotate around together with them. In addition the particles in the very agitation can condense again from another external cause, but in the condensation they cannot detach these small spheres so unrestrictedly, even when these are complete. Since they according to thesis 5 are pliable in different degrees, they can also easily curve their small branches little by little. But since this is the nature of most things, that while they are curved as the result of a condensation or any other motion, they immediately try to bring themselves back to their previous condition, but also since the same external power of motion can still remain, and they are so tightly condensed that they cannot let their small spheres loose unrestrictedly, it happens that all with great effort and eagerness without delay struggle to move away from each other and spread themselves out in a greater space. Besides countless other experiments into this matter, this is as evident as possible in guns loaded with air, in which the condensed air breaks out with such a great force that it can hardly be described. Here it must be noticed as regards the branch-like particles, that if they are too flexible and soft, the motion of the fluidity excepted, they check all motion in themselves, and they are not able to bring themselves back to their previous position. This happens for the same reason that we see that small globes move for much longer and with more ease on a naked table, than on a table where a cloth is laid, and that a ball that is sent into mud does not bounce back but goes into it, but on the contrary that one that has been thrown against a wall rebounds, and likewise in other cases. Such are snowflakes, which, since they are very soft and irregular just like wool, can check the power of almost every motion.

9.

Finally it is well-known that bodies, which move in such a way that they run into each other, in different degrees impart the motion to each other in proportion to the speed and determination of their internal mass. In addition we also see that a body that has a greater internal quantity is able to move only with greater difficulty than another, which is equal to it in size but of less weight, i.e. made up of another more porous substance. The former nevertheless retains its force longer than the latter, since it can acquire a greater motion because of its internal mass. For example it is true that a leaden globe is set in motion with more difficulty than one of wood that is equal to it in size, etc., but the former acquires a much greater quantity of motion, and retains it much longer than the latter. For if there is a force that is proportioned and sufficiently moving, it is able to throw forth a leaden globe further from itself than one of wood. This happens in all bodies with

proportione justa ratione molis, celeritatis, magnitudinis, materiae ac figurae, quae tamen omnia in subjecta materia calculo accurate subicere, operae pretium non est. Eodem modo etiam particulae aëris, quum per th. 5 variae sint inter sese magnitudinis sintque illae pro varietate materiae, anni temporum, tempestatum, dierum ac noctium, vel etiam meridiei ac vesperae aliarumque causarum nunc rariores aut densiores, nunc tenuiores aut crassiores, etiam necessario, ubi vis movens sufficiens adest, maiorem vel minorem motus agitationem et quantitatem gradatim acquirant.

X.

Praeterea notandum est quod particulae aëris aliave corpora, quamvis de pluribus simul motibus participant, suo tamen motu nunquam nisi unam tantum simplicem lineam describant. Quo ipso fit ut eadem illae particulae de variis admodum motibus simul participare aliisque eisdem communicare possint, ita ut omnes hi motus non multum sese invicem impendant. Si tamen unus illorum caeteris longe impetuosior fuerit, aliquo ipsis impedimento esse poterit, quo minus aequè libere ac alias expediantur. Sic experimur motum aëris vehementissimum, quem ventum appellamus, alios multos motus aliquantum impedire, ut caloris, etc.

XI.

Cum aër itaque ab aliqua causa externa versus aliquam partem impellitur, paululum condensatur. Quia vero particulae condensatae magnam habent vim in locum priorem iterum resiliendi per th. 8, statim quaedam illarum recurrunt. Quaedam in anteriores, superiores et inferiores irruunt easque premunt, atque iterum a resistentibus aliquantulum repressae in priorem locum redeunt. Hae postea rursus alias, atque ita deinceps iteratis saepe vicibus, quamdiu videlicet causa illa externa, quae pellit aërem, vel ab alio movetur vel motum priorem retinet. Hoc modo potest hic motus ad longam valde distantiam, et non tantum versus unam sed in omnes undique partes, brevi pertransire eodem prorsus modo, quo videmus lapidem in aquam immissum varios in aquae superficie circulos efformare. Qui circuli in aqua, quoniam plurimum faciunt ad rei huius illustrationem, paulo accuratius hic sunt considerandi.

the right proportion preserved as regards gravity, speed, size, substance and shape. It is, however, not worthwhile to subject everything in the investigated material meticulously to calculation. In the same way also the particles of air, since they are of different sizes in relation to each other according to thesis 5, and since they are now rarer or denser, now more tender or thick, depending on the variety of the substance, time of year, weather, day and night, or noon and evening, and other things, necessarily acquire a greater or lesser agitation and quantity of motion step by step, when there is a sufficient moving force.

10.

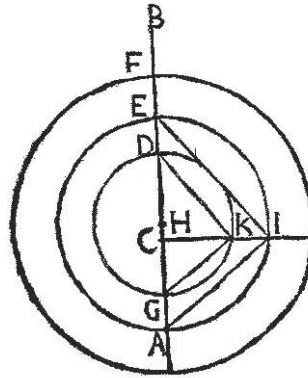
Moreover, it should be noticed that the particles of air, or other bodies, although they partake in several motions at the same time, never describe but one single line with their own motion. This is exactly why the same particles are able to partake in very diverse motions at the same time and to impart them to others, so that all these motions do not greatly impede each other. But if one of them is much more impetuous than the others, it can be of some hindrance to these, so that they are not released as unrestrictedly as otherwise. Thus we experience that the very violent motion of air, which we call wind, impedes many other motions somewhat, for example that of heat, etc.

11.

When air is thus impelled in some direction by some external cause, it is slightly condensed. But since condensed particles have a great power to rebound again to their previous place, in accordance with thesis 8, some of them turn back immediately. Some collide into the ones in the front, the upper ones and the lower ones, and press upon them, and having been slightly driven back again by the ones that offer resistance, they return to their previous place. Then these again go to another place, and so it continues repeatedly thereafter, namely as long as the external cause, which pushes the air, is either moved by something else or retains its previous motion. In this way this motion is able to traverse a very long distance within a short time, and not only in one but in all directions all around, quite in the same way as when we see that a stone, which has been thrown into water, creates various circles on the surface of the water. These circles in the water, since they contribute a great deal to the clearness of this matter, are here to be pondered upon somewhat more carefully.

- 100

12.



1. If the water is still and a stone is thrown forth vertically to the surface of the water, these circles cannot but be created both equally in all directions around and exactly as circles on the surface of the water. For there can then be no reason why they should go more in one direction than in another.
2. If, however, a stone is thrown vertically into a river, it is easily understood that these circles must move forth somewhat further in that direction, where the river goes in its entirety, than in the other direction. As for example: Let C be the centre in the water, into which a stone is thrown, and let the river be carried forward equally everywhere without any disturbance from A to B along line AB. Let there be the circles DEF, which the stone creates on the surface of the water, since every motion takes place in a certain time, with whatever speed indeed we imagine that these circles travel. But during the same time the entire water also completes a certain part of the line CB in a common motion. Let the circles thus move from C to F during one period of time, and the entire water from C to H during the same time. I say that these circles are not only transported such a great distance further away towards B than to A as is the line CH, but also that they are diminished so much exactly at A, that these lines become proportioned to each other, for as CG is to CD, CA is to CE, etc. For since the river is assumed to move forwards with equal speed, the lines AI and GK, as well as KD and IE and all others of that kind, cannot but become parallel in relation to each other. It is true that the circles in the water in this way can remain both exactly circular and parallel in relation to each other, but their centre is changed, i.e. it is transferred from C to H.
3. But if we assume that the river moves forward with unequal speed, say faster around D and E than around G, the line CD is increased according to the same proportion and CG reduced, and likewise in other cases.

4. Si praeterea flumen non aequè latum circa A ac circa D et E supponamus, etiam hoc dabit aliquam circulorum irregularitatem, tam per lineam CI eique oppositam, quam per lineam AB.
5. Ulterius, supponamus lapidem oblique in aquam projici. Quia vero tunc majori cum vi ac impetu versus unam partem quam oppositam fertur, ideo aqua, sive sit stagnans sive fluens, circulos dabit versus illam partem paulo latiores quam versus hanc. Qui tamen in flumine magis declinabunt quam in aqua quoad totum quiescente, juxta jam modo dicta, adeo ut tantum non indefinite possint hi circuli mutari ex varia aquae acceleratione ac inaequalitate, ut et anguli obliquitate prout lapis immittatur. Angulos enim obliquos quot esse statuunt Geometrae, facile notum est.
6. Ultimo, supponamus plures lapides in diversa aquae loca simul projici. Videbimus unumquemque suos circumquaque circulos efformare, qui quamvis in contrarias partes unus super alium simul ferantur, se invicem tamen non impediunt per th. 10.

XIII.

Circuli hi vel sphaerae etiam in omnes partes versus fundum ferentur, sed hoc tam facile ac in superficie non fiet. Observant enim Urinatores, secundum Gassendum, nullos in fundo fluctus, vel ad minimum non aequae sensibiles, notari posse. Multo igitur minus hi tales motus minores apparebunt.

XIV.

Denique, non putandum est easdem aquae particulas egredi a Centro Circuli versus ultimam circumferentiam. Sed quia ita inter sese conjunctae sunt, ut una alteram in aliquo suae superficiei puncto tangat, vel ad minimum non longe a se invicem distent, una trudet alteram, et haec rursus aliam et ita consequenter. Quo ipso fiet ut non multum a loco priori progressae plurimos simul motus alios recipere ac per longum celeriter spatium promovere facile possint.

XV.

Sunt autem aquae et aëris motus in hisce admodum similes, ita ut percepto motu aquae perfacile quoque sit de aëris motu judicare. Eodem enim modo, quo jam de aqua dictum est, etiam aëris particulae moventur per th. 11 talesque circulos in aëre efformant. Nota vero:

4. Moreover, if we assume that the river is not equally wide around A as around D and E, this also causes some irregularity in the circles, just as much along line CI, and the one opposite to it, as along line AB.
5. Let us furthermore assume that a stone is thrown forth obliquely into the water. Since it is then carried with a greater force and impulse in one direction than in the opposite, the water, be it still or flowing, produces somewhat wider circles in the former direction than in the latter. Those in the river nevertheless diverge more than the ones in the water that is entirely tranquil, in accordance with what was recently said, so that these circles can change almost endlessly as a result of the water's different acceleration and inequality, as well as of the obliqueness of the angle at which the stone is thrown into the water. For it is very well known how many oblique angles geometricians state that there are.
6. Let us finally assume that several stones are thrown forth into different places in the water at the same time. We shall see that each of them creates own circles all around themselves. Although these are carried in opposite directions one over the other at the same time, they do not impede each other, in accordance with thesis 10.

13.

These circles or spheres are also carried in all directions towards the bottom, but this does not happen as easily as on the surface. For divers observe, according to Gassendi, that no waves can be noticed at the bottom, or at least not any that are equally perceptible. Therefore the smaller motions of this kind are much less visible.

14.

Finally we should not think that the same particles of water go out from the centre of the circle towards its utmost circumference. But since they are joined to each other in such a way, that one touches another at some point of its surface, or since they are at least not very distant from each other, one pushes the other, and this again pushes another one, and so it continues. That is exactly why the ones that have not advanced much from their first place can easily receive several other impulses at the same time, and quickly move them on a long distance forwards.

15.

The motions of water and air are very similar in these respects. Therefore it is also very easy to judge the motion of air, when motion of water has been perceived. For in the same way, as has already been said about water, the particles of air also move, in accordance with thesis 11, and create such circles in the air. Notice however:

1. Quoniam in aëre talis superficies distincta non invenitur ac in aqua (ad illam enim quae terrae contigua est hic non attendo), non tantum in uno aliquo plano motus hi absolvuntur, sed per integram undique sphaeram in omnes circumquaque partes aequaliter vel fere aequaliter progrediuntur. Dixi fere aequaliter, quia aëris particulae quo altiores eo etiam subtiliores tenuioresque gradatim sunt per th. 6, et quo majores ac solidiores eo majorem habent vim in suo motu perseverandi juxta th. 9. Ex quibus rebus necessario sequitur motus hos per sphaeram in aëre formatos longius Horizontem versus quam sursum progredi debere.
2. Deinde, cum particulae hae aëreae in soni efformatione versus unam tantum plagam primum agitantur, motus hic versus illam plagam longius omnino penetrabit quam versus alias, juxta th. 12, n. 5, unde hae aëris fluctuationes tunc perfecte circulares esse non possunt.
3. Praeterea, si aër totus supponatur instar fluminis versus unam aliquam plagam ferri, ut in ventis fit, necessario longius hi circuli versus illam partem extendentur quam versus alias juxta th. 12, n. 2, ita ut notabiliter motus differentia hinc omnino produci possit.
4. Denique, si supponantur alii in aëre et ventis esse motus irregulares, ut sunt Prester, Typhon, Turbo, Exhydrias, Ecnephias, etc., etiam ad illos motus sensibilibus admodum hi circuli turbabuntur, et vel contrahentur vel extendentur vel aliis quibuscunque modis indefinite incurvabuntur, juxta th. 12 n. 5.
5. Ulterius, si fuerint plura corpora aërem agitantia, etiam ad quemcunque horum motuum circuli hi in quasvis partes aequaliter vel fere aequaliter efformabuntur per th. 12, n. 6.
6. Ultimo, ut Circuli tales in aqua non tantum formantur et promoventur, sive flumen per vias rectas sive curvas labatur, ita quoque in aëre facile per vias quasvis curvas ferentur.

XVI.

Cum hi tales Circuli seu vibrationes in aëre factae, atque perseverante motus causa, iterum atque iterum repetitae ad nostras aures progrediuntur. Organa auditus afficiunt atque ita in nobis sensum quendam efficiunt, quem sonum appellare solemus.

XVII.

Has tales vibrationes, seu cursus et recursus, etiam in aliis corporibus, ut praecipue in funependulis, observamus. Haec enim corpora cum ad motum semel incitantur, non nisi per plurimos saepius iteratos cursus ac recursus ad quietem tandem reducuntur. Quia autem hi cursus prioribus, quos in aëre

1. Since such a distinct surface cannot be found in the air as in the water (here I do not give heed to the one that is closest to earth), these motions are not only detached on one level ground of some kind, but proceed equally or almost equally in all directions around it in a sphere that is intact on all sides. I said almost equally, since the higher the particles of air go the finer and thinner they also gradually become, in accordance with thesis 6, and the bigger and more solid they are, the greater power they have to persist in their motion, in accordance with thesis 9. From these circumstances it necessarily follows that the motions that are fashioned as a sphere in the air must proceed longer towards the horizon than upwards.
2. Thereafter, when these aerial particles in the creation of sound are first agitated only towards one region, this motion penetrates very much longer towards that region than towards other ones, in accordance with thesis 12 number 5. Therefore these fluctuations of air then cannot be perfectly circular.
3. Moreover, if all the air is assumed to be carried like a river towards only one region, as happens in winds, these circles are necessarily spread out longer in that direction than in others, in accordance with thesis 12 number 2, so that a diversity of motion can be produced perceptibly entirely because of this fact.
4. If different irregular motions are then assumed to be in the air and in the winds, as *Prester*, *Typhon*, *Turbo*, *Exhydrias*, *Ecnephias*, etc., the circles are confused by these motions in a completely perceptible way. They are either assembled or spread out or endlessly curved in all other possible ways, in accordance with thesis 12 number 5.
5. Furthermore, if there are several bodies that agitate the air, the circles are equally or almost equally created in any direction by any of these motions, in accordance with thesis 12 number 6.
6. Finally, just as such circles in water are not only created and moved forwards, be it that the river flows in straight or winding paths, they are also easily carried in all kinds of winding ways in the air.

16.

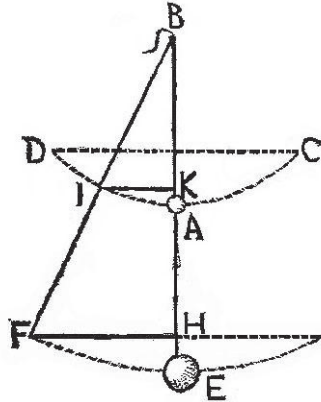
When such circles, or vibrations, have come about in the air, and while the cause of their motion is persistent, they proceed to our ears repeated again and again. They affect the organs of hearing, and they thus produce a certain sensation in us, which we usually call sound.

17.

We notice vibrations of this kind, or motions forwards and backwards, also in other bodies, and especially in pendulums. For when these bodies are once set in motion, they are finally brought back to rest only through several very often repeated motions forwards and backwards. But since these motions are

explicuimus, longe majores ac tardiores sunt et facile in sensus distincte incurrunt, eorumque velocitatem, crebritatem, proportionem, magnitudinem aliaque inter sese accuratius observare possumus, et ad soni vibrationes explicandas multum faciunt, eos propterea hic paulo exquisitius considerasse plurimum juvabit.

XVIII.



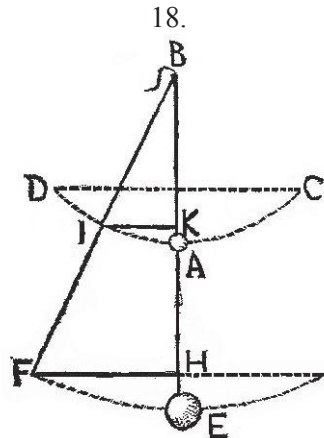
Sit ergo pondus A fune AB suspensum, quod, cum ab aliquo externo movetur versus C, statim iterum recurrit ad A, ubi non quiescit sed pergit versus D et iterum versus C, ita tamen ut ejus vis in unoquoque puncto minuatur fiantque vibrationes minores minoresque, donec omnino quiescat corpus in puncto A. Hujus rei explicationem qui desiderat, illam inveniet apud Mersennum in sua *Ballistica*, ubi ex professo talia pertractat.

XIX.

Primum autem notandum venit habere funem AB rationem vectis, et punctum B, a quo sustinetur corpus, rationem hypomochlij, et denique vim externam habere rationem potentiae moventis. Sint duo corpora, quorum unum A fune AB, et alterum E fune EB suspensum est, sitque linea EB ipsa AB duplo major. Est autem in vecte secundum leges Mechanicae: *ut distantia ad distantiam, ita reciproce potentia ad potentiam*. Hoc est, ut EB ad AB, ita potentia corporis E ad potentiam corporis A, et contra. Ergo:

1. Si sint pondera A et E aequalia, possitque vis 4 partium movere A usque ad I, poterit vis duarum partium aequè movere E ad F. Vel si sit E duplo majus ipso A, poterit aequalis vis utraque pondera aequè movere ad I et F. Quia enim sunt trianguula IBK et FBH similia, et latera IK et FH sinus angulorum oppositorum, erit IK ad FH ut BA ad BE. Est autem BA ad BE

also much bigger and slower than the previous ones, which we explained as regards the air, since they easily meet our senses in a distinct way, since we are able to observe their speed, frequency, proportion, size and other things more exactly in their relation to each other, and since they do much for the explanation of the vibrations of sound, it shall be very useful to have considered them somewhat more carefully here.



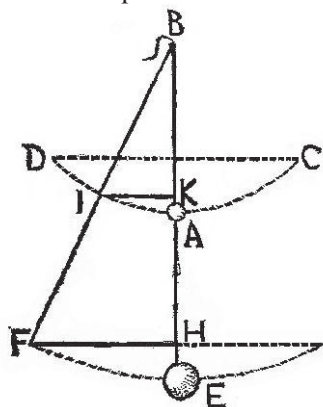
Let there thus be a weight A suspended in the rope AB, which, when it is moved towards C by something external, immediately turns back again to A, where it does not come to rest but continues towards D and again towards C, in such a way, however, that its force is weakened at each and every point, and its vibrations become smaller and smaller until the body comes completely to rest at the point A. He who desires an explanation of this matter finds it in Mersenne, in his *Ballistica*, where he explicitly treats such things.

19.

First it should be noticed that the rope AB serves as a lever, and the point B, from which the body is suspended, serves as a fulcrum, and finally the external force serves as a moving power. Let there be two bodies, one of which A is suspended in the rope AB, and the other E in the rope EB, and let the line EB be twice as long as AB. However, to the lever applies according to the laws of mechanics: *as distance to distance, so reciprocally power to power*. That is, as EB to AB, so the power of the body E to the power of the body A, and the contrary. Accordingly:

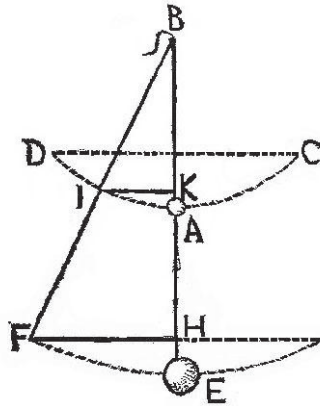
1. If the weights A and E are equal, and the force of four parts is able to move A all the way to I, the force of two parts is equally able to move E to F. But if E is twice as big as A, an equivalent force is able to move both weights equally to I and F. For since the triangles IBK and FBH are similar, and the sides IK and FH are the sines of the opposite angles, IK is to FH as BA to BE. But BA to BE is in a subduple

2. lineae IK et FH sunt duplae, etiam duplo celerius continuabit pondus A suas vibrationes quam corpus E, posita scilicet eadem vi movente in corpore A et E aequalibus. Id est eodem temporis spatio, quo E transit ad F, movebitur A ad I et rursus ad A. Quod spatium ipsi EF aequale est. Atque ita dum corpus E habuit exempli gratia 10, habebit A exacte 20 vibrationes, et posito corpus E ipso A duplo majus esse, movebitur A caeteris paribus ipso E quadruplo celerius. Hoc est dum E 10, A exacte 40 vibrationes absolvit.
3. Quia EB ipsius AB est dupla, corpus E quoque duplo diutius suum motum retinebit quam corpus A, ita ut si A moveretur per 10, movebitur E per 20 temporis momenta, et ita in reliquis.



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- proportion as a result of the construction. Thus the side FH is twice as long as KI. Having posited this, since
- the lines IK and FH are duple, the weight A also completes its vibrations twice as quickly as the body E, certainly provided that there is the same moving force in the equivalent bodies A and E. That is, in the same time as E goes over to F, A moves to I and back to A. This distance is equivalent to EF. And while thus the body E for example has 10, A has exactly 20 vibrations, and provided that the body E is twice as big as A, A moves, all other things being equal, four times as quickly as E. That is, while E completes 10, A completes exactly 40 vibrations.
 - Since EB is the double of AB, the body E also retains its motion twice as long as the body A, so that if A would move in 10, E moves in 20 moments of time, and likewise in other cases.



- Let now only the body A be considered. It is well-known that the vibrations are somewhat weakened in each and every point of the circle DAC, until the body itself comes completely to rest, and this according to the principle, that as much as it loses of the motion, it also loses of the distance. From this follows that, since the power of the motion is always proportional to the distance, all vibrations of the body A necessarily come about in precisely equal time. That is, in the same time as A moves to D and back to A, in the same space of time A moves to I and back to A. And since the points D and I have been chosen at random, the description applies to all points that can be imagined in the line DAC, to such a degree that how many vibrations there might ever be, all are nevertheless equally swift in time. And therefore length, weight, moving force, distance, frequency of vibrations and time itself are always exactly proportional to each other in such circumstances.
- From this also follows that the circles in the water and in the air that were described earlier, the greater and more remote from the center they are, the closer they also become in an appropriate proportion in relation to each other, but also that all of them, both the smallest and the largest, although they are

ferantur, eos tamen omnes et minimos et maximos aequali prorsus tempore spatia sua percurrere debere.

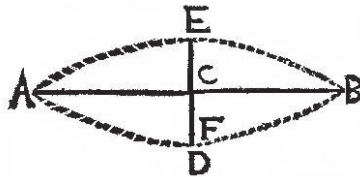
XX.

Hisce ita demonstratis recurro jam ad motum illum in aëre, ex quo sonum generari dictum est. Inter omnia autem necesse est illum motum ex causa aliqua externa oriri ac per aliquod tempus conservari, ut possint plures hae tales vibrationes unae post alteras fieri. Illa ipsa causa movens sunt corpora ista, quae instrumenta Musica appellare solemus. Sunt illa instrumenta duplicis potissimum generis, alia quae nervis seu chordis adaptantur, alia quae inflantur.

XXI.

Haec dum considero, invenio sonum duplici modo a corporibus oriri. Uno per vibrationes ipsius corporis sonantis repetitas quemadmodum fit, cum nervi et chordae pulsantur. Quae quoniam ipsaemet semel tactae satis diu moventur, motum tremulum aëri circumquaque communicant. Altero modo fit in aliis instrumentis, ut fistulis, etc., ubi nullum talem motum in ipso instrumento invenio, sed tantum quod ita constructa sit fistula, ut aërem ipsum ad hunc talem motum modificet. Qui duo modi adeo generales sunt, ut putem nullum in toto universo fieri sonum, qui non uno ex his oriatur. Quia autem motus ille in nervis multo est evidentior ac simplicior, illum primum explicandum aggrediar.

XXII.



Sit nervus AB in punctis A et B defixus. Illa duo puncta rationem hypomochlii habent, circa quae possit nervus moveri, suntque illa puncta omnino necessaria ut possit resonare. Quoniam autem sunt illa duo, habebit etiam nervus rationem duplicis vectis, puta CA ad hypomochlium A, et CB ad B. Potentia erit vis illa quae nervum movebit, quaecunque tandem sit. Tangatur jam nervus in aliquo sui puncto, ut exempli gratia in C, trahaturque ad D. Ille se statim retrahet in locum pristinum, juxta superius demonstrata, idque non solum ad C sed etiam ad E, rursusque versus D ac iterum versus E, et ita consequenter donec omnino quiescat in linea AB. Hac ratione continuabit hic nervus motum illum in aëre, quem th. 11 descripsi, ac ita resonabit.

carried like this along unequal distances, must traverse their distances in quite the same time.

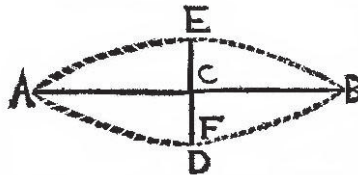
20.

Having described these things I now hasten back to this motion in the air, from which sound is said to be created. But among all things it is necessary that this motion comes about from some external cause, and that it is preserved for some time, so that more vibrations of this kind can appear one after the other. The very cause of this motion are the bodies that we usually call musical instruments. These instruments are above all of two different kinds, some that are equipped with strings or chords, some that are inflated.

21.

When I consider this, I find that sound comes about from bodies in a twofold way. The first is in the way it comes about by repeated vibrations of the sounding body itself, when strings and chords are struck. Since they move for a very long time when they have been touched just once, they impart this trembling motion to the air all around. In the second way it comes about in other instruments, as in pipes, etc., where I find no motion of this kind in the instrument itself, but only that the pipe is built in such a way that it regulates the air itself into this kind of motion. These two ways are so generally relevant, that I think no sound at all in the whole universe comes about that does not arise from one of them. But since the motion in strings is much more evident and uncomplicated, I shall attempt to explain this one first.

22.



Let the string AB be attached in the points A and B. These two points serve as fulcrums, around which the string can move, and these points are absolutely necessary for it to be able to resound. But since they are two, the string also serves as a twofold lever, suppose CA to the fulcrum A, and CB to B. The power is the force that moves the string, of whatever kind it may be. Now let the string be touched at some point along it, as for example in C, and pulled to D. It immediately withdraws to its previous place, in accordance with what was described above, and this not only to C but even to E, and back towards D and again towards E, and like that continuously until it comes completely to rest in line AB. In this way the string completes the motion in the air, which I explained in thesis 11, and thus it resounds.

Cum enim fertur nervus a C versus D, aër in illo spatio contentus tanta celeritate illi cedere nequit, quin ab illo versus D condensetur, atque ita per circulos majores versus omnes partes, ut saepius dictum est, agitetur, quoties hae vibrationes a nervo iterentur. Cum nervus ab E ad D ultro citroque ita recurrit, non putandum est illum in plano ECD ferri, sed omnino circa punctum C circulariter rotari, quasi puncta E et D ipsi AB ad perpendicularum in gyrum verterentur. Eo ipso enim fit, ut circulos illos in omnes partes per trinam dimensionem melius efficere possit, secundum th. 15, n. 1. Non autem puto puncta haec E et D perfectum circulum describere, sed latius se diffundere versus illam partem et ei oppositam, ad quam primum trahitur, juxta th. 12 n. 5, ita ut absolvant puncta haec E et D oblongam quandam sphaeroidem.

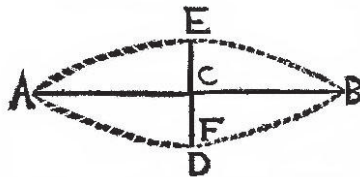
XXIII.

Ut autem possit hic motus sensibus nostris percipi, puto necessum esse, ut vibrationes hae ad minimum aliquoties iterentur. Fiunt enim illae tanta velocitate ac crebritate, ut nullo artificio, vel digitis vel alio modo (sicut est natura in omnibus suis operationibus fere inimitabilis), eas assequi valeamus. Si enim palmulam instrumenti alicujus polyplectri eadem crebritate, qua aliud corpus sonorum movetur, pulsare possemus, auderem affirmare palmulam ipsam eundem edituram sonum ac ipsum illud corpus.

XXIV.

Quanta vero celeritate hae vibrationes recurrant, facile non est determinare. Illae tamen ad certum tonum redactae fiunt, secundum calculum Mercenni ex *Harmonia minore*, ad minimum 50 uno secundo horae minuto, hoc est $1/3600$ parte horae. Quae vibrationes exacte faciunt sonum unisonum cum fistula organica octupedali, seu cum tubo aperto 8 pedum, adeo ut nervus tam laxus vel crassus, ut spatio secundi 16 duntaxat recursus faciat, vix auditum distincte feriat, ut de illo judicare quis possit?

XXV.



Quae denique sit harum vibrationum proportio in quolibet sono seorsim considerato, tradit etiam Mersennus, quod nimirum sit ut 19 ad 20, ut si

For when the string is carried from C towards D, the air that is contained in this space cannot give place to it with so a great speed, that it is not condensed by it towards D, and thus agitated in bigger circles in all directions, as has been said many times, as soon as the vibrations are repeated by the string. When the string in this way goes to and fro from E to D, one should not think that it is carried in an even ECD, but that it rotates completely in circles around the point C, as if the points E and D were turned vertically into a circle in relation to AB. For this is exactly why it can bring about those circles more easily in all directions in three dimensions, in accordance with thesis 15, number 1. However, I do not think that these points E and D describe a perfect circle, but that they spread themselves out more widely in this direction, to which it is first pulled, and in the one opposed to it, in accordance with thesis 12, number 5, so that the points E and D make up some kind of oblong spheroid.

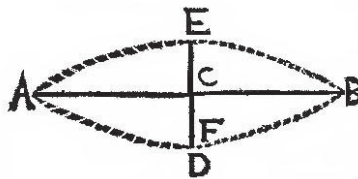
23.

In order for this motion to be able to be perceived with our senses, I think it is necessary that these vibrations are repeated at least several times. For they come about with such a great speed and frequency, that we cannot acquire knowledge about them with any artifice, neither with our fingers nor in any other way (as nature is almost impossible to imitate in all of its operations). For if we could strike the key of any polyplectrum instrument with the same frequency as another sounding body moves with, I would dare to assert that the very key would emit the same sound as the body itself.

24.

It is not easy to determine with how great a speed the vibrations recur. But those which have been brought to a certain tone, come about, according to the calculation of Mersenne in *Harmonia minor*, at least 50 times in only one second, that is, $1/3600$ part of an hour. These vibrations produce a sound that is exactly unison with an organ pipe of 8 feet, or with an open tube of 8 feet. Therefore a string that is so loose or thick that it produces merely 16 movements in the space of a second hardly strikes the hearing in a distinct way, so who can judge it?

25.



Finally, what the proportion of these vibrations is in a sound of any kind that is considered separately, Mersenne also relates, and this is evidently as 19 to

nervus AB prima vice trahatur ad D, altero recursu non pertinget nisi ad F, hac proportionem ut sit CF ad CD ut 19 ad 20, atque ita in reliquis.

XXVI.

Hoc modo oritur jam sonus in omnibus instrumentis Musicis, quae cujuscunque materiae chordis vel nervis adornantur, aliisque per plurimos, ut sunt varia instrumenta polyplectra (*Claver*), omnia Chelyum seu Violarum, Testudinum, Lyrarum, Tubarum genera. Praeterea omnia instrumenta pneumatica quae calamis inflantur, ut et omnes in organis tibiae lingulis (*Snarrwärck*) construuntur, quibus addantur omnes Campanae, tympana, omniumque animalium voces, et alia innumera.

XXVII.

Alterum modum, quo sonus oritur, illum esse dixi: cum instrumentum ipsum tales vibrationes aliquo sui motu non producit, sed tantum dispositive aërem ita modificat, ut particulae ejus hunc eundem motum tremulum acquirant eumque ad aures nostras pervenire faciant. Unde facile videtur quod respectu aëris solius, vel etiam nostri, sonus semper eodem modo conformatur ac dilatatur, quamvis respectu instrumentorum et causae moventis longe alia ejus sit ratio. Si autem aliqua ipsius corporis concussio etiam hic concedenda esset, illa tamen hoc loco in considerationem non venit, quia tantum ab aëre commoto oriri potest, adeoque nec ad soni productionem quicquam facit sicut nervus, qui ipsemet suo motu aërem ipsum commovet.

XXVIII.

Inter omnia talia instrumenta maxime vulgares sunt fistulae, quae sonum sane non injucundum edunt. Est autem hic sonus in fistulis aliisque hujusmodi corporibus explicatu demonstratuque adeo abstrusus et intricatus, ut quid hic dicendum sit vix occurrat. Quamdiu enim in hac quaestione resolvenda dubius haeserim, quamque illa me suis difficultatibus exercuerit, dicere vix possum. Nec ullum Musurgicum, quod quidem mihi videre licuit, adhuc inveni, qui sonum hunc in fistulis Physice demonstrare ex professo aggressus est. Et si forte aliquis quaestionem hanc attigit, illud non nisi breviter et ex accidenti nonnullis saltem verbis ab eo factum est. Hoc tamen apud illos inveni, quod sonum in fistulis ex motu quodam aëris tremulo similiter ac in nervis fieri consentiant. Quomodo vero motus hic excitetur, de hoc minime solliciti sunt.

20. So if the string AB is pulled to D in a first turn, it does not reach but to F when it returns the second time, so that CF to CD in this proportion is like 19 to 20, and likewise in other cases.

26.

In this way sound comes about in all musical instruments that are equipped with chords or strings of any kind of material, and in very many others, as for example various polyplectrum instruments (*Claver*), all kinds of *chelys*, or *violae*, lutes, lyres and trumpets. In addition all pneumatic instruments that are inflated through reeds, as well as all organ pipes that are built with tongues (*Snarrwärck*), to which should be added all bells, drums and voices of all living beings, and countless others.

27.

I said that the other way in which sound comes about was this: when the instrument itself does not produce vibrations of this kind through any motion of itself, but only regulates the air by disposition in such a way, that its particles acquire this same trembling motion, and make that it reaches our ears. Thereby it is easily seen that with respect to air alone, or even to our air alone, sound is always fashioned and amplified in the same way, although its explanation may be very different, depending on the instruments and the moving cause. But if some concussion of the body itself would have to be conceded also here, it does not come into consideration in this place, since it can come about from excited air only. In addition it does not do anything for the production of sound, as a string does, which itself excites the air with its motion.

28.

Among all the instruments of this kind pipes are the most common, which emit a sound that indeed is not unpleasant. But this sound in pipes and other bodies of this kind is so difficult and intricate to explain and describe, that it hardly comes to mind what should be said here. For I can hardly say how long I have remained in doubt while trying to solve this question, and how it has vexed me with its difficulties. Still I have found no music theorist, at least as far as it has been granted me to see, who explicitly has attempted to describe this sound in pipes from a physical perspective. And if someone has perhaps touched upon this question, this has been made by him only briefly and from the accidental merely with some few words. I find this in them, however, that they agree that sound in pipes comes about from some trembling motion of air, just like in strings. But how this motion is brought about, with this they are very little concerned.

XXIX.



Quia vero hanc mihi materiam explicandam assumpsi, ne hoc omnino praeteriisse videar, aliquam hujus motus rationem pro viribus in medium proferre volui. Hujus tamen rei si alius meliorem interim solutionem monstraverit, hac relicta illam lubens arripiam. Illos tremulos a fistulis hoc modo in aëre modificari puto: Sit fistula ABCD, quae per AE foramen inflatur. Notum est ibi meatui huic directe oppositam esse linguam satis acutam, ut est B. Cum ventus jam venerit ad B inque linguam illam impegerit, ob ejus resistantiam non potest non ab illa aliquantum reflecti versus E. Quia vero et ibi exacte contrarium sibi habet impetum venti succedentis, necessum est ut pars per foramen E in aërem liberum exeat, pars vero altera in fistulae cavitatem interioriorem transeat, ubi iterum aërem a fistula contentum pro ejus longitudine ac crassitie proportionaliter habet resistantem, itaque statim ibi condensatur per th. 11. Quia autem vim habet se iterum in spatium majus dilatandi per th. 8, eodem modo quo ex chorda demonstratum est, variae illae ac maxime veloces eodem fere tempore per totam fistulae cavitatem oriuntur aëris vibrationes, quae sensum soni in nobis efficiunt. Primum ergo formantur hae vibrationes in foramine illo EB atque ita sonum ibi revera generant. Ille vero sonus a tota fistula pro cavitatis ejus dimensione variis indefinite modis postea modificatur.

XXX.



Ad hujus vero motus confirmationem in fistulis sequentia experimenta feci:

1. Omnino inter foramen AE et linguam B justa proportio est observanda. Si enim haec distantia mutetur, alium statim sonum dabit fistula. Ut si lingua aliqua alteri ordinariae superimposita ad E nimis accedat, fistula non resonabit, quia spatium ipsis vibrationibus proportionatum tunc non erit.



But since I undertook to explain this material, lest I would seem to have left this completely without attention, I wanted to present some explanation of this motion, to the best of my ability. But if someone else meanwhile demonstrates a better solution of this matter, I shall abandon my own and gladly accept that one. I think that the trembles from pipes are regulated in this way in the air: Let there be a pipe ABCD, which is inflated through the opening AE. We know that a quite sharp tongue is placed directly against this passage, as B is. When the wind has come to B and struck into this tongue, it cannot but be somewhat reflected by it towards E because of its resistance. But since it also there receives an impulse by the succeeding wind that is exactly opposite to it, it is necessary that a part of it goes out into free air through the opening E, but that another part moves on into the inner cavity of the pipe, where it again meets with air contained in the pipe, which makes resistance in proportion to the length and thickness of the pipe, and thus it immediately condenses there, in accordance with thesis 11. But since it has the power to spread itself out more in space again, in accordance with thesis 8, in the same way as was shown with the string, these different and very swift vibrations of air, which produce the sense of sound in us, come about almost at the same time along the entire cavity of the pipe. The vibrations are thus first created at the opening EB, and thus they actually generate sound there. But this sound is thereafter regulated in endlessly different ways by the entire pipe according to the dimension of its cavity.



In order to confirm this motion in pipes I made the following experiments:

1. In general a correct proportion between the opening AE and the tongue B must be observed. For if this distance is changed, the pipe immediately emits another sound. If for example some tongue is placed upon the other ordinary one and comes too close to E, the pipe does not resound, since the space then is not proportioned to the vibrations themselves.

2. Si lingulam illam superadditam ducendo et reducendo attollere vel magis deprimere volueris respectu foraminis AE, fistula insignem soni differentiam circa acutum et grave mox reddet. Illa enim elevata major venti copia in fistulae cavitatem interiorem cogitur, sed vero magis depressa maxima venti pars in aërem liberum per foramen EB egreditur.
3. Si foramen EB superius occludatur, quamvis lingula ipsa B libera manserit, fistula tamen non resonabit, quia omnis tunc ventus intra fistulae cavitatem truditur, et nulla ejus pars in aërem liberum egreditur. Quod tamen omnino ad sonum requiritur.
4. Si foraminis EB aliqua pars operiatur secundum fistulae latitudinem, statim percipies magnam soni differentiam circa ejus profunditatem, idque justa proportionem prout magis vel minus obtegatur foramen, quia hoc modo statim mutatur prior illa proportio inter ventum qui in aërem reliquum egreditur et qui in ipsam fistulam intromittitur.
5. Si foramen FB penitus obturetur, ita ut lingula B usque ad F continuetur, fistula neque resonabit, quia nullus tunc ventus in ejus cavitatem intrat, quod tamen fieri ad soni generationem necessarium est.
6. Si lingula ipsa alia superimposita vel duplicetur vel triplicetur, etc., vel etiam si lingula ista adventitia ipsi fistulae ad perpendicularum erigatur, etiam magnam soni varietatem circa ejus latitudinem percipies, quia pro quantitate venti impingentis statim mutantur vibrationes.
7. Si lingula B aliquo modo laedatur, sonum reddet fistula priori longe obtusior, quia vibrationes ipsae ob lingulae rupturam aliter statim disponuntur.
8. Si fistula in D materia aliqua solida et compacta probe occludatur, sonum dabit a priori longe distantem ac varium illumque pro materiae soliditate ac intentione inflantis alium ac alium. Ut si fistula prius clavem F (ut est ibi ejus sedes) resonabat, reddet postea alium ab illo, vel per septimam inferiorem, ut est *g* grave, vel per quintam superiorem, ut est *c* superius, vel per octavam cum tertia, ut est *a* superius, vel per octavam cum sexta majore, ut est *d* excellens. Imo et plures soni simul audientur, quamvis haec intervalla in omnibus fistulis non semper observare liceat, sed pro varietate fistularum varie mutantur, quod minimum quodque momentum saepe producere potest. Quidquid sit, hinc tamen facile constat vibrationes illas in ipsa cavitare ab operculo in D reflecti versus EB foramen. Nihil

2. If you want to lift up or press down, with regard to the opening AE, the tongue that is attached above by bringing it forward and backward, the pipe soon renders a notably different sound with regard to high and low pitch. For when it is lifted up a greater abundance of the wind is forced into the inner cavity of the pipe, but when it is more pressed down, the greatest part of the wind goes out into open air through the opening EB.
3. If the opening EB is shut from above, although the tongue B itself remains unrestrained, the pipe does not resound, since the entire wind is then pushed within the cavity of the pipe, and no part of it goes out into the open air. But this is absolutely required for the creation of sound.
4. If some part of the opening EB is covered along the width of the pipe, you immediately perceive a great difference of sound as regards its pitch, and this in a suitable proportion according as the opening is more or less covered, since in this way the initial proportion between the wind that goes out into the other air and the one that is sent in into the pipe itself immediately changes.
5. If the opening FB is sealed up from inside, so that the tongue B is made continuous all the way to F, the pipe does resound, since then no wind enters into its cavity. It is, however, necessary that this happens for sound to be generated.
6. If the tongue itself is either doubled or tripled, etc., by another that is placed upon it, or even if this additional tongue is raised vertically in relation to the pipe, you also perceive a great difference of sound as regards its volume, since the vibrations immediately change in accordance with the quantity of the wind that strikes into it.
7. If the tongue B is damaged in some way, the pipe renders a sound that is much weaker than the previous one, since the vibrations themselves are immediately distributed in another way because of the fracture of the tongue.
8. If the pipe is properly closed with some solid and compact material at D, it emits a sound which is very distant to and different from the previous one, and which is always different depending on the solidity of the material and the intensity of the one who inflates. If for example the pipe first resounded the tone F (since its place is there), it thereafter renders one that is different from it, either at a seventh lower, which is *g grave*, or at a fifth above it, which is the *c superius*, or at an octave with a third, which is the *a superius*, or at an octave with a major sixth, which is the *d excellens*. Yes more sounds are also heard at the same time, although it is not always possible to notice these intervals in all pipes, but they change differently in accordance with the different characteristics of the pipes. Any of the slightest impulses can often cause this change. However it may be, it is hereby nevertheless very evident that the vibrations in the cavity itself are reflected from the cover at D towards the opening EB. For

- enim obstat quo minus possint plures vibrationes in contrarias sibi invicem partes simul penetrare per th. 14, et particulae aëris omnibus illis motibus inservire per th. 10.
9. Si foramen D alia materia molli ac prorsus irregulari leviter obturetur, fistula non resonabit. Quum enim materia haec motum omnem in se sistere potest per th. 8, vibrationes illae non reflectuntur, ut extra fistulam egredi possint.
 10. Si fistulam ad B per lineam BH obturaveris, nullus fiet sonus. Nam vento tunc aditus in fistulae cavitatem prorsus occluditur.
 11. Si operculum GF extrahatur, fistula non resonabit, quia ventus tunc recta per totam cavitatem sine aliquo impedimento perget.
 12. Si vero loco ipsius operculi laminam quandam in AF posueris, ita ut fiat foramen prius AE, fistula aequè clarum reddet sonum, sed tamen priori longè acutiorem, quia tunc vento liber datur regressus et exitus per foramen FG, ex quo etiam facile constat ipsum aërem in tubulo FD contentum vento paululum resistere posse.
 13. Si spatium totum FCH aqua impleveris, fistula non resonabit. Tunc enim vento liber aditus in fistulam denegatur. Quanquam autem etiam in aqua fieri possit sonus, ut fuit in th. 4, tamen, quia magna est differentia inter aëris et aquae densitatem, non potest unus idemque sonus a tam diversis mediis simul produci, ita ut ventus ex una parte in aëre libero et ex altera in ipsa aqua ad eundem motum disponantur. Hic enim longè alia est ratio, quam si vel sola aqua vel solus aër vel etiam aër aquae admixtus sonum produceret.
 14. Si totam fistulae cavitatem FD aqua repleveris, nec tunc fistula resonabit ob causam modo dictam.
 15. Si autem spatium aliquod ad B ab aqua vacuum relinquatur, sonum edet fistula valde acutum. Prout vero aqua versus D minuitur, ita etiam sonus in unoquoque puncto quoad profunditatem indefinite variatur.
 16. Si fistulam interius aqua solummodo madefeceris, proprium quidem tonum retinebit, sed qui in latitudine a priori multum differet. Tunc enim fistula ex aqua quasi levigatur. Nam possunt quaeque inaequalitates vel motum sistere vel aliquo modo impedire.
 17. Ultimo, si fistula foraminibus distinguetur, sonus exinde quoad profunditatem etiam indefinite variatur. Quod notius est quam ut illud explicare opus sit.

- nothing prevents several vibrations from penetrating in directions that are opposite to each other at the same time, in accordance with thesis 14, and that the particles of air can be subject to all these motions, in accordance with thesis 10.
9. If the opening D is slightly closed with another material that is soft and very irregular, the pipe does not resound. For since this material is able to check all motion in itself, in accordance with thesis 8, the vibrations are not reflected, so that they can go out outside of the pipe.
 10. If you close the pipe at B along the line BH, no sound comes about. For the entrance into the cavity of the pipe is then completely shut for the wind.
 11. If the cover GF is extended, the pipe does not resound, since the wind then continues straightforwardly through the entire cavity without any hindrance.
 12. But if you place some kind of lamina at AF instead of this cover, so that the opening first becomes AE, the pipe emits an equally clear sound, but one that is much higher than the previous, since a free way backwards and an exit is then granted to the wind through the opening FG. Hereby it is also very evident that the air itself that is contained in the small tube FD can offer some resistance to the wind.
 13. If you fill the entire space FCH with water, the pipe does not resound. For the wind is then denied a free entry into the pipe. But although sound can come about also in water, as was the case in thesis 4, since there is a great difference between the density of air and water, one and the same sound cannot be produced by so different media at the same time. Therefore the winds are by the same motion distributed in one way in free air, and in another in the water itself. For here the explanation is very different from what it would be if either water alone, or air alone, or even air mixed with water would produce sound.
 14. If you fill the pipe's entire cavity FD with water, nor does the pipe then resound for the recently mentioned reason.
 15. If some space at B is left empty from water, the pipe emits a very high sound. But as the water is lowered towards D, the sound is proportionally endlessly different as regards pitch at each and every point.
 16. If you merely moisten the pipe inside with water, it admittedly retains its proper tone, but it would differ much from the previous one in volume. For then the pipe is made smooth from the water, so to speak. For all inequalities can either check the motion or impede it in some way.
 17. Finally, if the pipe is divided with openings, sound is because of that also endlessly different as regards pitch. This is so well-known that it does not need an explanation.

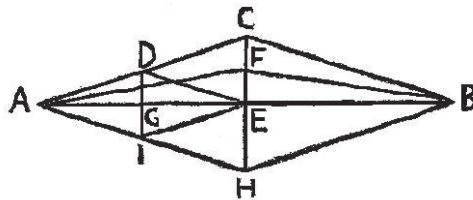
XXXI.

Ex his omnibus experimentis ac motus varietatibus facile puto soni generationem supra descriptam satis confirmari. Fit autem sonus modo hoc posteriori in omnibus organi tibiis quae lingulis immobilibus adornatae sunt, in cornuum omnium speciebus (vulgo *Cornett*), in fistulis omnibus aliis particularibus, in Castanetis, in rimulis januarum ac parietum, in tonitru, in tormentis, etc. etc. Non tamen nego in nonnullis corporibus, ut in tubis, tormentorum globis, aliisque plurimis, hos duos modos simul concurrere posse, unde etiam est quod tam varium sonum edunt, et quae sunt reliqua. Quod itaque de nervo illo in th. 22 et fistula hac nunc dictum est, idem de omnibus aliis instrumentis ac corporibus, quaecunque demum sint, ut ad omnia per totum universum corpora commode applicari possint, quod scilicet nullus unquam fiat sonus qui non aliquo dictorum modorum generetur.

XXXII.

Hinc statim ratio jam apparet quare nervus multo diutius resonet quam pulsatur, fistula vero nequaquam diutius quam inflatur. Quamprimum enim tibiam inflare quis desierit, etiam vibrationes ejus evanescent, quia nulla est vis quae ulterius cogit illas particulas ab E versus B. Itaque diutius hic motus durare non potest. Quod multo fit aliter in nervis vel chordis. Illae enim diu motum impressum in sese retinent, ac novas continuo vibrationes efformant. Si vero, statim ac mota fuerit chorda, eam digito retinueris, eodem etiam momento sonus ejus aequae ac in fistulis desinet. Itaque in omnibus corporibus sonoris, quaecunque demum sint, diutius sonus non durat quam vel ipsum instrumentum moveatur, vel etiam motus ille ab instrumento modificetur, non aliter quam dictum jam est.

XXXIII.



Cum nervus eo jam modo quo th. 22 demonstratum est ultro citroque movetur, erunt hae ejus vibrationes ratione longitudinis, crassitie, vis moventis, spatii, crebritatis ac temporis exacte sibi invicem proportionatae per th. 19. Nam caeteris paribus respondet crassities in nervis ipsi ponderi in funependulis. Sint itaque duo nervi AB et AE crassitie aequales, sed longitudine dupli. Dico eandem vim posse movere nervum AB ad C et H, quae movet AE ad D

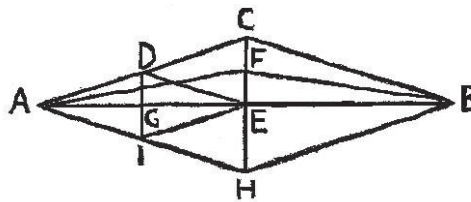
31.

From all these experiments and variations of motion I readily think that the generation of sound that was described above is confirmed enough. Sound comes about in this later way in all organ pipes that are equipped with immovable tongues, in all kinds of horns (in the vernacular *Cornett*), in all other special kinds of pipes, in castanets, in small cracks of doors and walls, in thunder, in cannons, etc. I do not deny, however, that these two ways can take place simultaneously in many bodies, as in trumpets, in cannon balls, and in several others, and this is also why they emit a so varying sound, and so on. Therefore what has been said about the string in thesis 22 and about the pipe now holds true about all other instruments and bodies, of whatever kind they may be, so that they can be suitably applied to all bodies in the whole universe, since evidently no sound ever comes about that is not generated in some of the mentioned ways.

32.

Hereby the explanation immediately becomes evident why a string resounds much longer than it is struck, but a pipe by no means longer than it is inflated. For as soon as anyone ceases to inflate a flute, its vibrations also fade away, since there is no power that forces the particles from E towards B any further. Therefore this motion cannot last longer. This happens in a very different way in strings or chords. For they retain the motion that has been pressed upon them for a long time, and continuously create new vibrations. But if you, as soon as the chord has been set in motion, hold it back with your finger, its sound also ends at the same moment, just as it does in pipes. Therefore in all sounding bodies, of whatever kind they may be, sound does not last longer either than the instrument itself is moved, or than the motion is regulated by the instrument, and in no other way than the now mentioned.

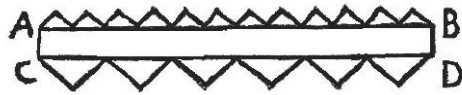
33.



When a string moves here and there, in the way that was described in thesis 22, its vibrations are exactly proportioned to each other as regards length, thickness, moving force, space, frequency and time, in accordance with thesis 19. For when all other circumstances are similar, the thickness in the strings corresponds to the weight in the pendulums. Thus let there be two strings AB and AE that are equal in thickness, but duple in length. I say that the same force can move the string AB to C and H, which moves AE to D

et I. Est enim ut CH ad AB, ita DI ad AE. Et dum AB nervus facit duas vibrationes, percurrent AE exacte 4 movebiturque AB duplo diutius quam AE, ac ita reciproce in reliquis, ut semper sint haec omnia inter se proportionata, quae satis quidem clara esse puto secundum th. 19. Nam eadem in omnibus est ratio. Inprimis autem hic omnino diligenter distinguenda est crebritas seu frequentia vibrationum a velocitate seu magnitudine earundem, haec enim a se invicem minime pendent. Ad velocitatem vibrationum vero nunc non attendo, quia sunt illae omnes vibrationes in unoquoque nervo tempore semper aequae celeres per th. 19 n. 4, ideoque hic in considerationem non veniunt. Caeteris autem positis ut prius, dico quod dum nervus AE quater, AB tantum bis recurret, vel, posito AB ipso AE etiam duplo crassiores esse, quod dum AE quater, AB non nisi semel vibrabit, vel denique, posito EB ipso AE quoque duplo crassiores, dico quod dum AE rursus quater, EB non nisi bis recurret, per rationes in th. 19 traditas.

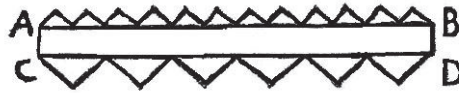
XXXIV.



His demonstratis, quia iam experientia certo constat nervos duos eadem vi tensos et longitudine et crassitie per se aequales eundem prorsus sonum continuo reddere, ut et alios vel longitudine inter sese duplos et crassitie aequales, vel etiam longitudine inter sese aequales et crassitie duplos, exacte per octavam resonare, atque ita in omnibus reliquis nervis secundum cuiusque proportionem, dico ex sola hac vibrationum crebritate et frequentia omne soni discrimen circa profunditatem, seu acutum et grave, semper oriri. Hoc idem confirmatur ex campanis et aliis omnibus ponderibus. Nam posito campanas eadem esse materia et figura, sed pondere duplas, reddent illae sonos per octavam inter sese distantes, ut et cursus ac recursus suos duplos, et ita in reliquis, servata semper proportione. Praeterea eandem etiam rationem invenire licet inter numeros radicales cuique sono proprios, ac est inter numeros vibrationum cuiusque corporis, ita ut haec omnia secundum numerum, pondus ac mensuram semper sibi invicem in omnibus exacte respondeant. Ulterius hoc etiam confirmatur ex bacillis in modum serrae dentatis, quales pueri in ludis usurpare solent, ut est AB et CD inter sese dupla. Si enim baculus AB et CD celeritate aequali ultro citroque juxta corpus aliud trahatur, CD ipso AB duplo gravius sonabit. Et si AB duxeris modo tardius modo duplo celerius, etiam

and I. For just as CH is to AB, DI is to AE. And while the string AB brings about two vibrations, AE performs exactly four, and AB moves twice as long time as AE, and likewise reciprocally in other cases, so that all of these are always proportional to each other, which I indeed think is clear enough according to thesis 19. For the explanation is the same in all cases. But above all the density or frequency of the vibrations must be very carefully distinguished from their speed or size, for they by no means depend on each other. However, I do not deal now with the speed of the vibrations, since all these vibrations are always equally swift in time in each and every string, in accordance with thesis 19 number 4, and therefore they do not come into consideration here. The other circumstances being posited as previously, I say that while the string AE goes back four times, AB only does so twice, or, posited that AB is twice as thick as AE, that while AE vibrates four times, AB does so only once, or finally, posited that EB is twice as thick as AE, I say that while AE again goes back four times, EB only does so twice, according to the principles related in thesis 19.

34.



Having described these things, since it is now settled for certain by experience that two strings, tensioned with the same force and mutually equal as regards both length and thickness, continuously render exactly the same sound, as well as that others that are either duple in length and equal in thickness in relation to each other, or even equal in length and duple in thickness in relation to each other, resound exactly at the octave, and likewise in all remaining strings in accordance with each one's proportion, I say that all the discrimination of sound as regards pitch, or high and low, always comes about only from this density and frequency of the vibrations. The same fact is confirmed in bells and all other weights. For posited that the bells are of the same material and shape, but duple in weight, they render sounds that are at the distance of an octave from each other, as well as duple motions forwards and backwards, and likewise in other cases, always with the proportion preserved. Moreover it is possible to find the same proportion between the root numbers that pertain to each sound, as it is between the numbers of vibrations of any body, so that all of these always correspond exactly to each other in all respects according to number, weight and measure. Furthermore this is also confirmed from staffs with teeth in the shape of a saw, such ones that boys usually make use of in games, since AB and CD are duple in relation to each other. For if the stick AB and CD is pulled here and there with equal speed close to another body, CD sounds twice as low as AB. And if you move AB now slower now twice as fast, also

ille per octavam sonabit. Nam ad motum cujusque dentis vibratio quaedam in aëre fit. Sed hi bacillorum soni adeo obtusi sunt, ut eorum distantia inter sese aequè bene ac in nervis vel aliis corporibus percipi non possit, certo tamen hoc constat illos ad celeritatem motus vel quantitatem dentium acutiores et graviores revera fieri. Et haec jam causa et fundamentum est omnium sonorum gravium et acutorum.

XXXV.

Eodem etiam modo se res habet in fistulis. Cum enim ventus in fistulae cavitatem ingreditur, aërem ibi contentum a se propellit, et hic rursus alium ac ita per totam fistulam, ut fiant hae tales vibrationes. Quia vero fistula quo major est, eo plus aëris intra sese continet, facile apparet majorem aëris copiam magis vento resistere quam minorem per th. 9. Ideo quo magis aër resistit, eo etiam tardius motum hunc recipit. Atque hoc modo sonus indefinite in fistula modificari potest, ac pro varia aëris resistentia modo gravior modo acutior reddi. Nec obstat quod soni graviores requirunt vibrationes tardiores, nam tantum etiam a vi remitti debet dum fistula inflatur, ut revera et tardiores et minores fieri possint. Quod si autem vim eandem adhibueris in sonis gravibus ac in acutis, nunquam debitum tonum dabit instrumentum, sed alium acutiorem. Hoc de fistulis, quas ore inflammas accipiendum est. In organis vero alia est ratio. Quamvis enim ibi eadem est vis movens tam in acutioribus quam gravioribus tonis, possunt tamen soni competentes produci, quia magnitudo fistularum proportionaliter ad sonum quemcunque variatur, adeo ut quantitas motus per magnitudinem fistulae compensetur. Sunt ergo haec omnino notanda, quia possunt plurimae difficultates in Musicis instrumentis prorsus admirandae ex hoc solo fundamento resolvi.

XXXVI.

Primum ergo facile datur ratio omnium experimentorum illorum quae in th. 30 adduxi, in quibus sonus quoad profunditatem variabat. In illis enim omnibus aëri liberior dabatur exitus e fistula, ut tantam vento non praeberet resistentiam. Quo fiebat ut vibrationes istae citius ac crebrius modificari, et ita sonus acutior reddi posset, secundum ea quae jam dicta sunt in th. 35. Ex quibus experimentis unusquisque etiam varios intelligere potest modos fistulas quascunque communes ita fabricandi, ut cum consonantia instrumentorum communi (vulgo *Chormässigh*) exacte concordent. Quales tamen fistulas, propter artificum inertiam ad hoc usque tempus, nonnisi cum summa querela longe rarissime invenire potuerunt Musici.

this sounds at the octave. For at the motion of every tooth a certain vibration comes about in the air. But these sounds of the staffs are so weak, that their distance to each other cannot be perceived equally well as in strings or in other bodies, but surely it is evident hereby that they in fact become higher and lower depending on the speed of the motion or the quantity of the teeth. And this is the cause and foundation of all low and high sounds.

35.

The matters stand in the same way in pipes. For when wind goes into the cavity of the pipe, it drives away from itself the air that is contained there, and this again drives away another, and like that through the entire pipe, so that these kinds of vibrations come about. But since the bigger a pipe is, the more air it contains within itself, it is very evident that a greater abundance of air offers more resistance to the wind than a smaller, in accordance with thesis 9. Therefore the more resistance the air offers, the slower it also acquires this motion. And in this way sound can be endlessly regulated in the pipe, and in accordance with the varying resistance of the air now be rendered lower now higher. Neither is it a problem that lower sounds require slower vibrations, for one must only weaken the power when the pipe is inflated, in order to enable them to really become both slower and smaller. But if you apply the same power in low sounds as in high, the instrument never emits the correct tone, but another that is higher. This must be agreed upon concerning the pipes that we inflate with the mouth. But in organs the explanation is another. For although there is the same moving force both in higher and lower tones, adequate sounds can be produced, since the sizes of the pipes vary in proportion to every sound, so that the quantity of motion is compensated through the size of the pipe. These facts should thus be especially noticed, since several quite astonishing difficulties in musical instruments can be solved only from this foundation.

36.

First we thus easily notice the explanation of all the experiments that I presented in thesis 30, in which sound varied as regards pitch. For in all of them air was given a freer way out from the pipe, so that it did not offer such great resistance to the wind. Thereby it happened that these vibrations could be regulated more rapidly and frequently, and thus a higher sound rendered, in accordance with what has already been mentioned in thesis 35. From these experiments each and every one can also understand the different ways of construing any of the common pipes in such a way, that they are exactly in concord with the general consonance of the instruments (in the vernacular *Chormässigh*). Musicians have, however, because of the idleness of the craftsmen up to this time, been able to find pipes of this kind only very rarely and with very many complaints.

XXXVII.

Deinde unicuique facile notum est fistulam quamcunque, si in tonis gravioribus majori cum impetu infletur quam ille sonus requirit, statim per Diapason praecise resonare. Fundamentum hujus rei petitur ex th. 35. Sit igitur sonus ille exempli gratia in f , qui gravissimus est in fistulis. Si aliud jam esset instrumentum majus, revera hic idem tonus non solum admitteret, sed et necessario requireret majorem vim per th. 9 et 35. Sed jam in hac fistula, si ad tonum hunc f major adhibeatur vis, quam ut possit aër in illa contentus debita celeritate ad illum spatium commode propelli, quod huic sono proportionatum est, statim vibrationes hae iterum in unoquoque reliquarum vibrationum puncto reflectentur, atque ita revera duplicabuntur. Hoc autem facto necessario audietur sonus a priori per Diapason distans, cujus est proportio dupla. Nihil enim aliud ad hoc requiritur quam vibrationum dupla crebritas per th. 34. Tali similitudine res videtur posse illustrari: sicut clavus ferreus per saepius iteratos parvos ictus in parietem facile trudi potest, ita sonus per debitam inflandi vim justus producitur. Si vero clavus una vel altera vehementiori percussione cogatur, magisque trudatur quam ut particulae in trunco illi cedere possint, statim incurvatur et parietem non ingreditur (neque enim possunt particulae trunci in alium ordinem tam celeriter disponi, sed necessario aliquod temporis momentum ad situm mutandum requirunt). Similiter etiam, si ventus super ordinariam vim augeatur, sonus idem effici nequivit, sed alius in ejus locum substituitur. Nec eadem est ratio cum reliquis sonorum intervallis, quia eorum inter sese proportio tam simplex non est ut octavae. Si enim a priori tono Diapente fistula resonaret, eodem tempore quo prius duae fiebant vibrationes, fierent postea tres, ut est quintae proportio, quod fieri vix potest in tonis majoribus, ut mox videbimus.

XXXVIII.



Dictum est praeterea in th. 30 n. 8 fistulam undiquaque probe oclusam primum reddidisse sonum septima graviolem, cujus ratio haec est: cum fistula in D obturatur, quasi duplicabitur, necessario enim debent vibrationes in D iterum reflecti ad foramen EB, quia exitum alium non inveniunt. Hoc autem facto facile constat longe majorem jam fieri aëris resistentiam quam si

37.

Then everyone can easily notice that a pipe of any kind, if it in the lower tones is inflated with greater force than the sound requires, immediately resounds precisely at the diapason. The foundation of this matter can be found in thesis 35. Let therefore the sound for example be in f , which is the lowest in pipes. If there would now be another bigger instrument, this same tone would in fact not only allow, but necessarily also require a greater force, in accordance with theses 9 and 35. But in this pipe, if so a great force is used for the tone f , that the air that is contained in it cannot be properly pushed forward with due speed to the space that is proportioned to this sound, the vibrations are immediately reflected again in each and every spot of the remaining vibrations, and thus in fact duplicated. When this has taken place, sound is necessarily heard at the distance of a diapason from the previous one, the proportion of which is duple. For nothing else is required for this than a duple frequency of vibrations, in accordance with thesis 34. The circumstance can seemingly be illustrated with a similitude of this kind: just as an iron nail can be easily struck into a wall with small hits that are repeated often, a correct sound is brought about by an inflation with due force. But if a nail is hit with one or another strike that is more violent, and struck so much that the particles in the trunk cannot give way to it, it is immediately curved and does not go into the wall (for neither can the particles of the trunk be distributed that quickly into another order, but they necessarily require some moment of time in order to change places). In a like manner, if the wind is increased beyond the customary force, the same sound cannot be produced, but another is there in its place. The explanation is not the same with the remaining intervals of sounds, since their proportions are not as simple as that of an octave in relation to each other. For if a pipe should resound at the distance of a diapente from the previous tone, in the same time as two vibrations came about previously, three would come about thereafter, which is the proportion of the fifth. This can hardly happen in greater tones, as we shall soon see.

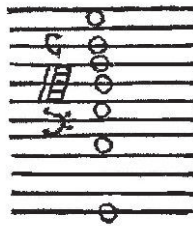
38.



Moreover, it was said in thesis 30 number 8 that a pipe that is properly covered on all sides had first rendered a sound at a seventh lower, the explanation of which is this: when the pipe is closed at D, it is doubled, as it were, for necessarily the vibrations at D must again be reflected towards the opening EB, since they do not find another way out. From this result, it is very evident that the air's resistance now becomes much greater than if it

aperta esset. Si autem fistula exacte duplicaretur, id est spatium FD vel duplo longius vel duplo crassius redderetur, necessario sequeretur illam tonum priori per Diapason praecise graviorem omnino daturam per th. 35. Jam vero non sonat nisi tonum septima graviorem, ita ut saltem restet tonus ad octavam, cujus proportio est ut 10 ad 9. Si ergo dividatur linea FD in 10 partes et 9 exinde sumantur, restat adhuc decima pars versus D, itaque data hac venti proportionem in illo nono divisionis puncto incipient vibrationes hae in fistula reflecti versus E. Quod dum fit, erit aëris resistentia priori tot gradibus major, ut resonet fistula septimam graviorem. Praeterea dictum est in eadem thesi fistulam postea majori vi inflatam reddidisse sonum quinta acutior, cujus rei eadem est ratio. Nam quantum ad vim addebatur, tanto etiam celerius vibrationes necessario iterantur. Si ergo sextuplo intensius jam fistula infletur quam prius, reddet sonum quinta priori superiorem. Tanto enim spatio prius incipient vibrationes reflecti a D, quanta est quintae proportio, videlicet ut 3 ad 2. Non enim potest eadem aëris quantitas quemvis impetum venti aequaliter sustinere. Si vero alia esset fistula major, priorem illum tonum ex hoc impetu venti facillime posset resonare, sicut clavus ferreus parvus eosdem ictus excipere non potest ac magnus, quin ab illis statim incurvetur. Haec itaque est ratio ac causa talium sonorum, quicunque demum sint in eodem instrumento, quorum calculus facillime adhiberi potest, si modo servetur proportio inter vim moventem et aëris quantitatem, putoque nullam sonorum difficultatem occurrere circa acutum et grave, quae non ex hisce solvi possit. Sed hi soni in variis fistulis saepe varie mutari possunt, et in aliis plures et aliis pauciores exaudiri, quorum causa minima quaeque fistulae conditio esse potest, itaque sufficiat generalem rationem adduxisse.

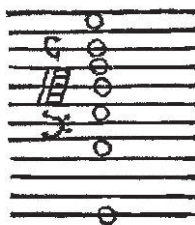
XXXIX.



Sunt praeterea nonnulla instrumenta Musica, in quibus omnes soni ex sola venti remissione ac intensione per modum jam traditum produci possunt, quorum praecipua sunt tubae bellicae, etc. Est autem in his tubis admirabile

had been open. But if the pipe should be exactly doubled, i.e. the space FD should be rendered either twice as long or twice as thick, it would necessarily follow that it would in general emit a tone that is exactly at a diapason lower than the previous one, in accordance with thesis 35. Furthermore it does not sound but a tone a seventh lower, so that only a tone remains in distance to the octave, the proportion of which is as 10 to 9. If the line FD is thus divided into 10 parts and 9 are taken away from there, a tenth still remains towards D, and when this proportion of the wind is thus given, the vibrations in the pipe begin to be reflected towards E in this ninth point in the division. When this happens, the air's resistance is greater than the previous one by so many degrees, that the pipe resounds at the lower seventh. Moreover it was said in the same thesis, that a pipe that was thereafter inflated with a greater force had rendered a sound at a fifth higher. The explanation of this matter is the same. For as much as was added to the force, the vibrations are necessarily repeated more rapidly by the same degree. If thus a pipe is now inflated six times more intensely than previously, it renders a sound that is a fifth higher than the previous. For the vibrations first begin to be reflected from D at such a great distance, as is the proportion of a fifth, namely as 3 to 2. For the same quantity of air cannot sustain every impulse of the wind in the same way. But if there should be another bigger pipe, it could very easily resound the previous tone as a result of this impulse of the wind, just as a small iron nail cannot receive the same strikes as a big one, but is immediately bent by them. This is the explanation and cause of such sounds, of whatever kind they may be in the same instrument. A calculation of them can very easily be applied, if we only give heed to the proportion between the moving force and the quantity of air, and I think that no difficulty of sounds occurs as regards high and low that cannot be solved from them. But these sounds can often change differently in different pipes, and more can be heard in some and fewer in others. Every condition of the pipe can be their slightest cause, and thus it is enough to have presented a general explanation.

39.



Furthermore there are several musical instruments, in which all sounds can be produced merely from a weakening and intensifying of the wind in the manner hereby related, particular of which are war trumpets, etc. In these

prorsus quod continuo incremento assurgant, idque non nisi secundum notulas hic appositas, ita ut primo per octavam, deinde per quintam, postea per quartam, quam sequitur ditonus et rursus quarta, posteaque omnes in ordine soni per integram octavam. Estque hoc ipsi tubae adeo naturale, ut vel os tibicinis vel tuba ipsa potius frangatur, quam possint haec dicta intervalla mutari. Quare autem et quomodo possint variae aëris vibrationes ex sola venti remissione ac intensione oriri, modo dictum est, sed haec tamen manet difficultas, quare hos omnino tonos tantum reddat et non alios, ut et quare iidem soni in unoquoque octavae ascensu inveniri non queant, sed quod pro augmento octavae solummodo varient. Ratio autem haec est: ex superioribus quidem constat sonos graviores ex vibrationibus tardioribus ac majoribus oriri, itaque videntur illae alias proportionibus intermediis ac suo modo incommensurabiles admittere non posse, sed quamprimum ventus magis intenditur quam ut cedere possit aër, statim vibrationes iterum reflecti et duplicari juxta th. 37, et hanc ob causam resonat tuba primum octavam. In altero ascensu eadem quidem est ratio de octava ipsa, sed quia ventus adhuc magis augetur et vibrationes proportionaliter celeriores ac minores redduntur, videntur illae aliquam aliam adhuc proportionem in sese admittere posse, sed talem quae non nisi maxime simplex sit. Illa vero alia esse non potest quam quinta, itaque illa proxime sequitur. De tertio octavae ascensu sit idem iudicium, et quia vibrationes hic iterum minores et crebriores fiunt – et sonus quo acutior est, eo facilius in partes minores, ob minorem vibrationum differentiam, dividitur – etiam adhuc alii partitioni inservire possunt vibrationes, omnium autem maxime regularis jam sequitur Diatessaron. Denique in ultima octava, quia ventus ibi adeo intenditur et vibrationes valde crebrae ac parvae fiunt, ad quasvis proportionibus ac divisiones cogi facile possunt, unde omnes omnino sonos jam producere potest tibicen. Haec est illa, quam ego quidem excogitare potui, admirabilis hujus arcani ratio, quae si minus placuerit, meliorem certe magno cum desiderio exspectabo.

XL.

In aliis praeterea corporibus quibusdam sonoris hoc invenio peculiare, quod illa pulsata nunquam unum simplicem, sed semper plures simul sonos reddant. Qualia sunt imprimis campanae omnes, inter quas aliae duos, aliae tres diversos tonos uno tempore producunt. Ad minimum autem semper duos maxime praevalentes, eosque per quartam communiter inter sese distantes efficiunt. Causa horum sonorum est duplex Campanarum superficies, interna puta et externa.

trumpets it is quite wonderful that they rise in a continuous increase, and this only according to the notes that are indicated here, so that they rise first with an octave, then with a fifth, thereafter with a fourth, which a ditone follows and again a fourth, and thereafter all sounds in order through the entire octave. This is so natural to the trumpet, that either the mouth of the trumpeter or the trumpet itself is broken rather than the aforementioned intervals could change. Why and how the different vibrations of air can come about merely from the weakening and intensifying of the wind was recently mentioned, but this difficulty nevertheless remains, why it in general renders only these tones and not others, as well as why the same sounds cannot be found in each and every ascent of the octave, but that they merely differ depending on the increase of the octave. The explanation is this: it is indeed evident from the aforementioned that lower sounds come about from slower and greater vibrations, and therefore they are seemingly not able to allow other proportions that are intermediary and incommensurable with their own measures, but as soon as the wind is so intense that the air cannot give way to it, the vibrations immediately seem to be reflected again and doubled, in accordance with thesis 37, and for this reason the trumpet first resounds at the octave. It is true that the explanation of the octave itself is the same in the second ascent, but since the wind is still more increased and the vibrations are proportionally rendered swifter and smaller, they seem to be able to allow yet some other proportion for themselves, but only one that is as simple as possible. This cannot be another than the fifth, and therefore it follows most closely. For the third ascent of the octave the judgment must be the same, and since the vibrations here again become smaller and more frequent – and the higher the sound is, the more easily it is divided into smaller parts, because of the smaller difference between the vibrations – even still other vibrations can be subject to the partition, but as the most regular of all now the diatesseron follows. Finally in the last octave, since the wind is there so intense, and the vibrations become very frequent and small, they can easily be forced into any proportions and divisions, and that is why the trumpeter is able to produce all possible sounds. This is the explanation of this remarkable secret matter that I could reason. If it is unpleasant, I shall of course desirously look forward to a better one.

40.

Furthermore I find this peculiarity in some other sounding bodies, that they when they have been struck never render one simple sound, but always several at the same time. Such are especially all bells, among which some produce two, some produce three different tones at the same time. But at least they always bring about two that are the most powerful, and these are generally at the distance of a fourth from each other. The cause of these sounds is the twofold surface of the bells, namely the inner and the outer.

Quia enim superficies interna minor est quam externa, ideo etiam illa hac celerius suas vibrationes absolvit, et ita necessario acutius sonabit per th. 34. Observant autem communiter fusores hanc proportionem in campanis fundendis, ut sit superficies interna ad exteriorem ut 3 ad 4, quod experientia satis constat. Itaque dum interior absolvit 4 vibrationes, exterior non nisi tres dabit. Quotiescunque autem haec est illarum proportio, illi necessario soni a se invicem per Diatessaron distabunt, atque ita in reliquis. Praeterea neque interior neque exterior superficies eandem ubique latitudinem habet, unde alii rursus soni facile peragi possunt, sed non aequae observabiles ac priores. Quod autem possint superficies ut et partes campanae tam variis motibus simul vibrari, hinc constat, quod si campanam claviculo quodam leviter tantum pulsare quis voluerit, deprehendet illam sonum suum proprium non fundere sed alium multo acutiorem, argumento certo campanam tunc secundum totum sui non vibrari, sed quoad partem tantum, quae si a campana sejuncta esset, etiam hunc eundem prorsus sonum efficeret. Si praeterea campanam fortius fortiusque pulsaveris, illa ratione virium moventis graviolem gradatim sonum producet. Quod facile evincit majorem tunc campanae portionem ad motum quam antea impelli. Quod idem observare licet in vitris, alium enim sonum dabit pes, alium reliqua pars, quae tamen materia metallis longe solidior est. Imo, si quis tabulam vitream construi faciat, inveniet illam omnes indefinite sonos revera fundere posse. Quo enim propiores fiunt centro, eo etiam acutiores evadunt.

XLI.

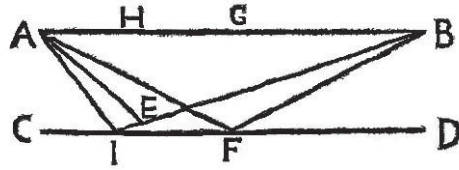
Ut autem ulterius progrediar, quia plurimae adhuc quaestiones de soni profunditate explicandae restant, ad nervos iterum redeo, quorum natura ad majorem rei evidentiam diligentius expendenda est. Nervi illi qui maxime usurpantur, sunt vel ex intestinis animalium vel ex metallis, quorum omnium maxime variabiles sunt illi qui ex fibris animalium conficiuntur, quia partes eorum magis cedunt, et aliqualem fluidi rationem habent. Cum nervus jam clavulo circumducto tenditur, singulae particulae se invicem magis magisque premunt, ut revera fiat et longior et tenuior, unde sequitur quod sonum acutiorem secundum proportionem pressionis omnino tunc dabit. Cum autem aliquandiu intactus mansit, per omnes suas partes aequaliter tensus est. Si ergo vel ad sonum graviolem vel ad acutiorem celerius mutetur quam ut possint omnes ejus particulae subsequi et situm mutare, omnes illae partes ad situm priorem se statim reducere conantur. Hinc fiet ut, si nervus celeriter intendatur, statim reddat sonum magis magisque graviolem. Si vero remittatur, dabit sonum sensim acutiorem.

For since the inner surface is smaller than the outer, the former also detaches its vibrations more rapidly than the latter, and thus it necessarily sounds higher, in accordance with thesis 34. The founders generally observe this proportion when founding bells, so that the inner surface in relation to the outer is as 3 to 4, which is evident enough through experience. Therefore, while the inner detaches four vibrations, the outer emits but three. Every time when this is their proportion, the sounds are necessarily at the distance of a diatessaron from each other, and likewise in other cases. Furthermore neither the inner nor the outer surface has the same width everywhere, and that is why yet other sounds can be easily produced, but not ones that are as readily observed as the earlier ones. That the surface as well as the parts of the bell can vibrate from such different motions at the same time, is evident from this circumstance, that if anyone wishes to strike the bell only gently with some kind of small stick, he discerns that it does not emit its proper sound but another that is much higher. This is a sure evidence that the bell then does not vibrate according to its entirety, but merely with respect to a part, which if it should be separated from the bell, would also bring about exactly this same sound. Furthermore, if you strike the bell harder and harder, it gradually produces a lower sound, in proportion to the power of the one who moves it. This clearly proves that a greater portion of the bell is then set in motion than previously. It is possible to notice the same thing in glasses, for the foot emits one sound, the remaining part another. This material, however, is much more solid than metal. Yes, if anyone sets about to build a table of glass, he shall find that it is in fact able to produce all sounds endlessly. For the closer to the center they are when they come about, the higher in pitch they also turn out.

41.

However, in order to go on further, since several questions about the pitch of sound still remain to be explained, I again return to the strings, the nature of which must be considered more carefully for a greater clarity in this matter. The strings that are used most are either made from animal intestines or from metal. Of all these, those that are the most changeable are made from the entrails of animals, since their parts are more yielding, and act like some kind of fluid. When the peg has been turned and the string is stretched, all single particles press upon each other more and more, so that it in fact becomes both longer and thinner. Hereby it follows that it then in general emits a higher sound in accordance with the proportion of the pressure. But when it has remained untouched for a while, it is equally tense in all its parts. If it thus changes either to a lower sound or to a higher so rapidly that all of its particles cannot follow and change places, all of the parts try to bring themselves back at once to their previous places. That is why, if a string is stretched out rapidly, it immediately renders a sound that becomes lower and lower. But if it is slackened, it emits a sound that is gradually higher.

XLII.



Mirabitur forte quispiam quomodo possit nervus eundem semper sonum peragere, in quocunque demum puncto pulsetur, cum facile appareat illum a linea sua recta non aequè extendi. Ut sit exempli gratia nervus AB, ducaturque linea CD ipsi parallela. Dico per th. 19 quod, si nervus tangatur in G, haec eadem vis eum longius a linea sua recta trahet quam in ullis aliis punctis. Fiet autem idipsum ad F. Posito autem quod aequali semper vi tendatur, necessario circa focus circumductus describet ellipsin. Quoniam ergo, per 52 tertii *Conicorum* Apollonii, omnes lineae in ellipsi, ut AE, BE, et AF, BF, simul sumptae sunt maximae Diametro, adeoque sibi invicem aequales, facile constat nervum, in quocunque puncto pulsetur, eundem semper sonum daturum. Si enim ultra Ellipsin ducatur, ut ad I, satis apparet lineas AI et BI ipsis AF et BF majores esse, quamvis sint triangula AIB et AFB inter sese aequalia, ut Mathematicis in confesso est.

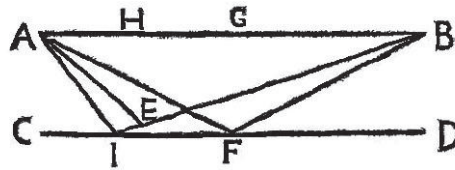
XLIII.

Quum itaque nervus eundem edat sonum in quocunque sui puncto tangatur, sit ut propter majorem commoditatem semper prope magadium pulsetur. Si enim in medio nervorum pulsus fieret, longe majorem inter sese distantiam ad vibrationes suas libere absolvendas requirerent per th. 42, atque ita si pares essent numero, instrumentum ipsum in immensam cresceret magnitudinem. Praeterea hoc posito nervus tam facile cederet, ut commodum pulsum non admitteret. Denique si arcu in medio sui moveretur, vibrationes liberas vix, ac ne vix quidem, habere posset, sed magis ab arcu impediretur, ita ut non nisi strepitum quendam ederet.

XLIV.

Saepius dictum est superius nervos ita eundo et redeundo vibrationes suas majores in initio, deinde gradatim minores, usque dum omnino quiescant, perficere. Quia autem, quo majores sunt hae vibrationes, eo majus spatium eodem tempore percurrunt, et quo vehementius pulsantur, eo majorem reddunt sonum, dico in hac sola vibrationum quantitate omnem soni latitudinem tantum consistere,

42.



Someone shall perhaps be astonished at how a string is always able to perform the same sound, in quite whatever point it is struck, since it is very evident that it is not stretched out equally from its straight line. Let there for example be the string AB, and let the line CD be drawn parallel to it. I say, in accordance with thesis 19, that if the string is touched at G, this same force pulls it longer from its straight line than at any other points. This very event takes place at F. But having posited that it is always stretched out with an equal force, the perimeter necessarily describes an ellipse around its focal points. Thus, according to paragraph 52 of Apollonius's third book on *Conics*, since all lines in an ellipse, as AE, BE, and AF, BF, are longest at its diameter when considered together, but also equivalent in relation to each other, it is very evident that the string, in whatever point it is struck, always emits the same sound. For if it is drawn beyond the ellipse, as to I, it is very clear that the lines AI and BI are longer than AF and BF, although the triangles AIB and AFB are equivalent in relation to each other, as mathematicians acknowledge.

43.

Although a string thus emits the same sound at whatever point of itself it is touched, it should, since it is more convenient, always be struck close to the bridge. For if the strike should take place in the middle of the strings, they would require a much greater distance between each other in order to detach their vibrations unrestrictedly, in accordance with thesis 42, and if they should thus be equal in number, the size of the instrument itself would greatly increase. Moreover, having posited this, the string would yield so easily that it would not allow a convenient strike. Finally, if it should be set in motion with a bow in its middle, it would hardly, and not even hardly, be able to have unrestricted vibrations, but it would rather be impeded by the bow, so that it would not produce but some kind of noise.

44.

It has frequently been said above that strings by going and returning in this way bring about their greater vibrations at the beginning, thereafter gradually smaller ones, right until they come to rest completely. But since the greater the vibrations are, the greater space they pass through in the same time, and the more violently they are struck, the greater sound they render, I say that all volume of sound merely consists in this mere quantity of

sicut ex earundem crebritate profunditatem oriri dictum est. Quia ergo omnes uniuscujusque corporis vibrationes tempore quidem sunt aequales per th. 19, n. 4, sed non aequae veloces et magnae, hinc fit ut nervus, quantum in se est, eandem quidem soni profunditatem, sed non eandem semper latitudinem retinet. Quod autem hic de nervo dictum est, etiam de omnibus in universum corporibus intellectum volo.

XLV.

Quoniam itaque vibrationes sonorum graviorum eodem tempore et majus spatium percurrunt, et diutius motum retinent per th. 19, hinc sequitur quod, si instrumentum ipsum vim illi sono proportionatam admittere possit, secundum ea quae th. 35 dicta sunt, tunc sonus gravis acutiori longe majorem habebit latitudinem, id est longius audietur. Dixi vim proportionatam admittere, non enim omnis sonus cuique instrumento ratione molis ac capacitatis est aequae naturalis, eamque ob causam, si sonus ille mutetur, necessum est tantum de vi movente etiam remitti debere, quantum ad gravitatem augetur per th. 35. Est itaque haec major latitudo de instrumentis illis solummodo intelligenda, quorum corpus et vis movens gravitati soni omnimode est proportionata. Nam in uno eodemque nervo, qui modo remittitur modo intenditur, vel in alio corpore, a quo diversi gradatim soni oriuntur, hoc non procedit, sed potius contrarium verum erit. Tunc enim soni graviores revera tardius per spatia aequalia pertransibunt. Hinc ergo sequitur quod instrumenta juste adornata quo fortius pulsantur, eo vehementius resonabunt.

XLVI.

Quia vibrationes hae vel sensim ita minuuntur, ut fit in nervis et chordis, etc. vel etiam magis magisque uniuntur aut evanescunt, ut fit in tubis, etc., itaque instrumenta omnia in certa auditoris distantia longe jucundissime resonabunt. Hinc sequitur primo quod instrumenta polyplectra multo suaviorem reddant sonum quam pneumatica, secundo quod soni acutiores in minima distantia aures nostras multo vehementius ferire poterunt quam graviores.

XLVII.

Praeterea quia eadem particulae aëris plurimis simul motibus subservire commode possunt per th. 10, nec multum a loco suo recedunt per th. 14, fiet ut plurimi simul soni nobis clare repraesentari possint.

vibrations, just as it was said that pitch comes about from their frequency. Since all vibrations of each and every body are thus admittedly equivalent in time, in accordance with thesis 19 number 4, but not equally swift and great, it is the case that the string, as much as it is in itself, admittedly retains the same pitch of sound, but not always the same volume. What has been said here about the string, I even want to be understood as regards all bodies in the whole world.

45.

Since therefore vibrations of lower sounds at the same time both run through a greater space, and retain the motion for a longer time, in accordance with thesis 19, it follows that, if the instrument itself can be compatible with a force that is in proportion to the sound, according to what was said in thesis 35, a low sound then has a much greater volume than a higher one, i.e. it is heard at a greater distance. I said 'be compatible with a force in proportion', for not every sound is equally natural to every instrument in terms of mass and capacity, and for this reason, if the sound changes, it is necessary that as much of the moving force must also be diminished, as is increased for the low pitch in accordance with thesis 35. Therefore this greater volume should merely be understood as regards those instruments, the body and moving force of which are entirely proportioned to a low pitch of sound. For in the one and same string, which is now slackened and now stretched, or in another body, from which different sounds gradually come about, this does not appear, but rather the contrary is true. For then lower sounds in fact pass right through equivalent spaces more slowly. Hereby it thus follows that instruments that are correctly equipped resound more forcefully, the stronger they are struck.

46.

Since these vibrations are either gradually diminished in such a way, as in strings and chords, etc., or since they are rather more and more united or fade away, as they do in trumpets, etc., all instruments resound by far most delightfully when the listener is at a certain distance. Hereby follows first that polyplectrum instruments render a much sweeter sound than pneumatic ones, secondly that higher sounds can strike our ears much more violently at a very small distance than the lower ones.

47.

Moreover, since the same particles of air can be subjected to several motions at the same time without problems, in accordance with thesis 10, and since they do not recede greatly from their place, in accordance with thesis 14, it is the case that several sounds can be clearly represented to us at the same time.

XLIIIX.

Quia denique circuli hi in aëre, quo remotiores sunt a centro, hoc est ab instrumento sonoro, eoque inter sese propiores per th. 19 n. 5, sequitur quod sonus omnis inaequali celeritate per spatia aequalia semper feratur, sed eadem proportionem qua latitudo, etiam velocitas soni continuo minuatur.

XLIX.

Si corpus sonorum versus unam praecipue plagam directe convertatur, sonus omnis versus illam partem multo longius quam versus alias omnes semper penetrabit per th. 15, n. 2.

L.

Si fuerint venti, omnes etiam soni versus illam plagam, qua fertur ventus, per multo longius spatium necessario audientur per th. 15, n. 3.

LI.

Si fuerint alii motus ventorum irregulares, ut sunt prester, Typhon, turbo, etc. ad hos quoque motus soni varie quoad latitudinem mutabuntur, et vel longius vel brevius, vel celerius aut tardius omnino percurrent per th. 15, n. 4.

LII.

Si fuerint particulae aëris nimis rarefactae aliisque per plurimis motibus valde agitatae, ut sunt tempore meridiano in aestate, fiet ut sonus ad solitam distantiam tam facile audiri non possit per th. 10 ac fit vespertino.

LIII.

Si fuerint particulae aëris nimis molles ac irregulares, ut tempore quo ningit, tunc sonus solitam latitudinem prorsus non habebit, quia particulae tales motum in se vel prorsus sistunt, vel ad minimum deminuunt per th. 8, unde est quod sonus tunc temporis tam obtusus redditur. Ita, eandem ob causam, comperimus instrumenta Musica in aedibus vacuis quam in aliis hominibus repletis, in aedibus nudis quam tapetis adornatis multo clarius et vehementius sonare. Imo, ipsum instrumentum vividiorum dare sonum cum in mensa nuda, quam cum in alia tegmine superstrata collocatur. Sic experimur sclopetum tempore hyberno versus nivem, nuper praecipue delapsam, displosa consuetum suum sonitum non modo non reddere, sed vix

48.

Since finally these circles in the air, the further away from the centre they are, i.e. from the sounding instrument, the closer they are to each other, in accordance with thesis 19 number 5, it follows that every sound is always carried across equal distances with an unequal speed, but in the same proportion as the volume, also the velocity of the sound is continuously diminished.

49.

If the sounding body is directly turned especially towards one area, every sound always penetrates much further in that direction than in all others, in accordance with thesis 15 number 2.

50.

If there are winds, all sounds are also necessarily heard at a much greater distance towards that area, where the wind is carried, in accordance with thesis 15 number 3.

51.

If there are other irregular motions of winds, such as the whirlwind, the cyclone, the tornado, etc., the sounds also change differently as regards volume according to these motions, and they in general travel through them either in a longer or shorter way, either more swiftly or more slowly, in accordance with thesis 15 number 4.

52.

If the particles of air are too rarified, and much agitated by several other motions, as they are in the summer at noon, it is the case that the sound cannot be so easily heard at the usual distance, in accordance with thesis 10, as it can in the evenings.

53.

If the particles of air are too soft and irregular, as at the time when it snows, then the sound by no means has its usual volume, since such particles either completely check the motion in themselves, or at least lessen it, in accordance with thesis 8, and this is why the sound is rendered so dimly at that time. Thus, for the same reason, we find that musical instruments sound much more loudly and strongly in empty buildings than in other ones that are full of people, and in uncovered buildings more than in ones that are adorned with tapestries. Yes, we find that the instrument itself produces a more vigorous sound, when it is placed on a unclothed table, than in another where a cloth has been laid. Likewise we experience that guns that have been fired against snow in the winter, especially against recently fallen snow, not only fail to render their customary sound, but they hardly render one that is

illi similem. Sic quoque certum est sonos ab aliis liquoribus, ut est lac, oleum, etc., adeo obtusos, et magis magisque graves pro ratione medii ejusque densitatis elici, ut nullam fere jucunditatem nobis adferre possint, et quaecunque sunt alia experimenta huc pertinentia, quae cuivis ubique fere obvia esse possunt.

LIV.

Si fuerint particulae aëris magis condensatae, crassae ac solidae, ut sunt tempore hyberno, et quidem vespertino, matutino et praecipue nocturno in aestate, per th. 6 fiet ut sonus his temporibus longe clarior et vehementior omnino evadat per th. 9, quod cuique notum esse puto. Quod tamen de vi omni sono ac instrumento proportionata omnino intellectum volo juxta th. 35 et 45. Posita enim hac aëris conditione requiritur ad sonum eundem major vis movens per th. 9. Alias contrarium eveniet, ut scilicet longius aestate quam hyeme audiat, etiam per th. 53. Quantum vero ad illud quod noctu melius auditur sonus quam die, addi et potest ratio haec, quod noctu omnia sunt quieta et ab aliis tumultibus libera, quod non parum faciet ad soni cujusque promotionem per th. 10. Sic comperimus Campanas pro varia aëris temperie multo longius et clarius audiri quam aliis temporibus, unde evidenter probatur aërem tunc aliis particulis omnino repletum esse. Quod adeo certum est, ut ex sola soni varietate de aëris tempestate brevi futura asseveranter pronunciare possint illi, qui ad talia attendunt. Sic notum est sonum etiam post pluvias quoad latitudinem non parum variari, quia remanent adhuc in aëre plurimi vapores aquei per th. 6.

LV.

Si fuerint particulae aëris magis vel minus subtiles, etiam exinde sensibilis prorsus variatio sonorum fiet quoad eorum latitudinem per th. 4 et 9. Sic experimur sonum in montibus altissimis adeo debilem reddi, ut in considerationem venire vix possit, cujus experimentum insigne apud Varenium exstat in *Geographia Generali* l. 1. prop. 41. Huc etiam pertinet experimentum illud de sono in vitro Hermetice sigillato et ab aëre vacuo, qui ob medii subtilitatem vix sensibilis reddi potest. Experimentum ipsum videre est apud Kircherum in sua *Musurgia*, Mersennum in *Harmonia majore Latina*, Jeriche *De spatio vacuo*, et Robertum Boyle in *Experimentis Physico-Mechanicis*, aliisque. Quia ergo facile obtineri potest particulas

similar to it. Likewise it is also certain that sounds become so dampened by other fluids, such as milk, oil, etc., and lower and lower in accordance with the medium and its density, that they offer us very little pleasure, and whatever other experiments there are that belong here, they are obvious to everyone almost everywhere.

54.

If the particles of air are more condensed, thick and solid, as they are in wintertime, and admittedly in the evenings, in the mornings and especially at night in the summer, it is the case, in accordance with thesis 6, that sound in general ends up much clearer and stronger at these times, in accordance with thesis 9. I think this is well-known for everyone. This, however, I want to be entirely understood from force being proportioned to every sound and instrument, in accordance with theses 35 and 45. For having posited this condition of the air, a greater moving force is required for the same sound, in accordance with thesis 9. Otherwise the contrary is the result, namely that it is heard at a greater distance in the summer than in the winter, also in accordance with thesis 53. But as far as the fact is concerned that sound is better heard at night than in daytime, also this explanation can be added, that at night everything is calm and free from other alarm. This contributes not a little to the promotion of any kind of sound, in accordance with thesis 10. Likewise we find that bells depending on the varying air temperature are heard at a much greater distance and much more clearly than at other times. Thereby it is clearly verified that the air is then completely filled with other particles. This is so certain, that they, who pay attention to such things, can earnestly foretell the air's immediate future weather merely from the difference of sound. Likewise it is well known that sound varies not a little as regards volume also after rain, since much watery vapour still remain in the air, in accordance with thesis 6.

55.

If the particles of air are more or less subtle, there is for this reason also a readily perceptible variation of the sounds as regards their volume, in accordance with theses 4 and 9. Likewise we experience that such a weak sound is rendered in very high mountains, that it can hardly come into consideration. A distinguished experiment into this matter can be found in Varen's *Geographia generalis*, book 1, proposition 41. To this pertains also the experiment on sound in glass that has been hermetically sealed and is empty from air, which can hardly be rendered in a perceptible way because of the subtlety of the medium. The experiment can be seen in Kircher's *Musurgia*, in Mersenne's *Harmonia major Latina*, in von Guericke's *De spatio vacuo*, and in Robert Boyle's *Experimenta Physico-Mechanica*, and in other places. Since it can thus be easily maintained that particles of air are on an equal

aëris in aequali altitudine esse, et magnitudine et soliditate plus minus aequales, sonus versus Horizontem longius penetrabit, quam versus alias partes per th. 9.

LVI.

Quanta vero celeritate sonus ab uno loco in alium communiter transferatur facile non est determinare, quum tot modis, ut jam dictum, variari possit. Ne tamen quaestio haec prorsus in dubio relinquatur, aliqua Philosophorum testimonia hac de re adducam. Mersennus in sua *Ballistica* soni velocitatem tantam esse affirmat, ut 230 sexpedas seu pedes 1380 spatio unius secundi minuti conficere possit, tantam autem esse unam sexpedam, ut 2500 faciant Leucam Gallicam, et tantam denique unam Leucam ut 7200 totum terrae ambitum comprehendant. Eandem prorsus celeritatem determinat in suis *Harmonia minore*, Lib. 2, et postea confirmat in *Harmonia majore Latina*, ubi calculum ulterius extendens concludit, *tormenti fragorem satis validum et vehementem terrae ambitum 7200 Leucarum quamdiu labuntur XXII horae confecturum*. Cum ipso quoque consentit Gassendus in *Philosophia Epicuri*. Kircherus vero in *Arte magna Consoni et Dissoni*, lib. 9, paulo minorem soni celeritatem probare contendit. Qua in re tam illustrium virorum experientias solum adduxisse sufficiat. Sed posset forsan dubitari, num aequalis sit soni gravis ac acuti celeritas per spatium aequale, quod omnino affirmandum esse puto juxta th. 19 n. 2, si modo intelligatur sonus esse ipsi instrumento proportionatus juxta th. 35 et 45. Sin minus, ut in illis instrumentis quae varios sonos procudunt, puto contrarium verum esse, quia tunc secundum moventis remissionem vibrationes revera fiunt tardiores per spatia aequalia. Quibus addi potest et hoc, quod omnes soni graviore tardius a nobis quam acutiores percipiuntur, propter vibrationum crebritatem minorem, quamvis hoc vix sensibile esse existimem.

LVII.

Quaeri etiam solet quam longe possit sonus communiter audiri, sed neque hoc ab aliquo certo determinari posse existimo, cum sit non nisi respectivum ad organa nostra. Ut enim unus praestantiori gaudet auditu quam alter, ita etiam multo facilius et longius sonum percipere potest. Deinde per quantam distantiam penetrare possit sonus ipse, nec certo dijudicari posse arbitror, quum ille, juxta jam dicta, innumeris modis saepissime mutetur. Aliqua tamen testimonia in hujus quaestionis illustrationem etiam apponam. Kircherus in *Arte magna Consoni et Dissoni*, lib. 9, non dubitat affirmare *tormentorum bellicorum explosiones ad nonaginta milliarium spatium prospero praesertim vento audiri*, ubi etiam narrat de *cornu Alexandri Magni tam vehementis soni, ut illo totum exercitum quantumvis dispersum*

altitude, and more or less equal in size and solidity, sound penetrates longer towards the horizon than in other directions, in accordance with thesis 9.

56.

With how great a speed sound is generally carried over from one place to another is not easy to determine, since it can differ in so many ways, as has already been said. However, lest this question is completely left in doubt, I shall adduce some evidence from the philosophers on this matter. Mersenne in his *Ballistica* asserts that the velocity of sound is so great that it can traverse 230 fathoms, or 1380 feet, in the space of only one second. But also that one fathom is so great, that 2500 of them make up a French *lieue*, and finally that one *lieue* is so great that 7200 of them enclose the entire perimeter of the earth. He settles quite the same speed in his *Harmonia minor*, book 2, and later he confirms it in the *Harmonia major Latina*, where he extends the calculation further and concludes that: 'the noise of a cannon that is strong and violent enough will travel through the earth's perimeter of 7200 *lieues* in 22 hours'. Gassendi also agrees with him in *Philosophia Epicuri*. But Kircher in his *Ars Magna Consoni et Dissoni*, book 9, makes an effort to prove that the speed of sound is somewhat lower. In this matter it should be enough merely to have adduced the experiences of such illustrious men. But it could perhaps be doubted, if the speeds of a low and a high sound are equal along an equal distance, which I think must be entirely asserted, in accordance with thesis 19 number 2, provided that the sound is understood to be proportioned to the instrument itself, in accordance with theses 35 and 45. If not, as in those instruments that produce different sounds, I think the contrary is true, since the vibrations then in fact become slower along equal distances, according to the abatement of the moving force. To this can be added also the fact that all lower sounds are perceived more slowly by us than the higher ones, because of the smaller frequency of the vibrations, although I think that this is hardly perceptible.

57.

It is usually also examined from how great distance sound in general can be heard, but neither can this I think be settled by anyone with certainty, since it is but relative to our organs. For as one person has better hearing than another, he can also perceive sound much more easily and from a greater distance. How great a distance sound itself would then be able to travel, I think cannot be decided for certain, since in accordance with what has already been said, it very often changes in countless ways. I shall nevertheless also append some evidence for the clearness of this question. Kircher in his *Ars magna consoni et dissoni*, book 9, does not hesitate to assert that 'the explosions of war-cannons are heard at a distance of ninety miles, especially in a fair wind.' There he also tells about 'the horn of Alexander the Great that had such a violent sound, that he with it so

ita perfecte stiterit ac si praesens loqueretur. Mersennus in Harmonia majore latina, l. 2 fatetur tormenta bellica majora, quae dicuntur Canons et Artillerie, frequenter a decem Leucis audiri, sed nescimus ubi desinat sensibilis illorum Sphaera. Sunt enim quae referunt in quibusdam obsidionibus a 60 Leucis, praesertim si flumina juvent sonum, audita fuisse, et statim, Certum est tamen non audiri tonitruum sonum a tanto spatio ac tormenta illa bellica.

LVIII.

Satis jam dictum est quomodo sonus ex diversitate medii multifariam prorsus variatur. Unde, ex eadem occasione, mihi quaestio occurrit quare et quomodo sonus ab ipsis instrumentis quoad latitudinem insigniter promoveri et multiplicari possit. Notum est instrumenta omnia Musica esse cava. Quae cavitas in ligneis instrumentis a tabula quadam lignea ex materia potissimum molli, ut est pinus et abies, constructa occludi solet. Cum instrumentum jam pulsatur, tabula illa sonora ob partium suarum mobilitatem hos tremulos in se facillime recipit. Quia denique illa majorem habet vim ad motum diutius retinendum quam aër ipse per th. 9, has aëris vibrationes et adjuvat et multoties in instrumento multiplicat, unde est ille clangor vel resonantia (ut ita dicam), quam in omnibus fere instrumentis observare licet. Cum autem nervi vel chordae omnes magna prorsus vi tabulam hanc sonoram per magadium premunt, facile constat quam necessarius sit clavulus ille ligneus, qui intra corpus ipsum tabulam hanc sustinet, ut et quantum momentum in justa ejus collocatione situm sit, imo quod debeat omnino et magadium et clavulus hic etiam ex ligno molli adornari. Alias enim insignem soni differentiam omnino efficient. Adde quam plurimum faciat figura totius instrumenti, ut et ipsarum partium seorsim, ad sonum promovendum, aliaque adeo ut possint hic tot causae particulares concurrere, quarum minima quaeque maximi saepe momenti est, ut illae omnes vix determinari possint. Hinc est quod nec idem instrumentum in cunctis aedibus pro varia earundem structura, imo nec in eadem domo pro varia collocatione, eandem semper retineat soni latitudinem vel ad minimum eandem jucunditatem, et quod nec omnia instrumenta ab eodem artifice et eadem materia fabricata eundem edunt sonum, et quae sunt caetera. Est enim longe certissimum nullum prorsus instrumentum vi satis valida unquam pulsari, quin omnes ejus particulae de motu hoc tremulo aliquantisper participant, quod variis modis probari potest. Unde facile apparet quot modis singulae partes pro varia conditione sonum possint impedire, ut ostensum est in th. 53. In aliis praeterea instrumentis observo esse quandam partem corpori ipsi sic affixam, ut ad ipsius vibrationes illa ipsa pars quoque tremat, ut est in

perfectly halted the entire army, no matter how scattered it was, as if he spoke to them face to face.’ Mersenne in *Harmonia major Latina*, book 2, acknowledges that ‘greater war-cannons, which are called *canons* and *artillerie*, are often heard at the distance of ten *lieues*, but we do not know where their perceptible sphere ends. For there are people who relate that they have been heard at the distance of 60 *lieues* in some sieges, especially if rivers promote the sound’. And immediately ‘it is, however, certain that the sound of thunder is not heard at such a great distance as these war-cannons’.

58.

It has already been said enough how sound differs completely in many ways depending on the diversity of the medium. Thereby, from the same occasion, the question occurs to me why and how the sound from the instruments themselves can be notably extended and increased with respect to volume. It is well-known that all musical instruments are hollow. This cavity is in wooden instruments usually covered by a wooden table that is preferably made of a soft material, like pine and fir. When the instrument is played, this sounding table receives these vibrations in itself very easily, because of the mobility of its parts. Since it then has a greater power to retain the motion longer than the air itself, in accordance with thesis 9, it both gives support to these vibrations of air and multiplies them many times in the instrument. This is why the blast or resonance (so to speak) takes place, which can be noticed in almost all instruments. But when all strings or chords press upon this sounding table with quite a great force at the bridge, it is very evident how necessary this wooden stick is, which supports the table within the very body, but also how great importance is centred on its proper position, yes that both the bridge and this stick must in general also be made of some soft wood. For otherwise they in general produce a notably different sound. Add to this how much the shape of the entire instrument, as well as each and every part, does for the promotion of sound, and other circumstances, so that so many particular causes can coincide here, of which even the smallest is often of the greatest influence, that all of them can hardly be settled. This is why neither does one and the same instrument always retain the same volume, or at least the same charm, in all buildings, depending on their different structures, no not even in the same house, depending on its different location, and nor do all instruments made by the same craftsman and the same material produce the same sound, and so on. For it is very certain that absolutely no instrument is ever played with a force that is strong enough, so that all its particles for a while take part in this vibrating motion. This can be proved in different ways. Hereby it is very evident in how many ways each and every part can impede sound depending on its different condition, as was shown in thesis 53. Moreover, in other instruments I notice that there is some certain part that is attached to the body itself in such a way, that this very part also trembles from its own vibrations, e.g. in the

tympano Cylindrico (vulgo *Trumma*), in tuba Marina (*Trumpet Marin*), ex qua magadium ex una sui parte mobile ac tremulum tabulam sonoram continuo verberat, ac sonum instrumenti admodum auget aliterque modificat. Quod etiam constat ex fragmentis nervorum in Violis, si tabulam illam solummodo tetigerint, et qui alij esse possunt modi perplurimi. In aliis praeterea instrumentis et praecipue Pneumaticis, ut sunt tubae, cornua, etc., solet sonus insigniter adaugeri per varias curvaturas, a quibus vibrationes ipsae multifariam reflectuntur et multiplicantur, unde est quod talia instrumenta curva multo longius audiuntur quam alia directa. Est autem in unoquoque instrumentorum genere circa hanc latitudinem aliquid peculiare. Quae omnia recensere operae pretium non est, nam illa ex his generalibus, quae dicta jam sunt, facile intelligi posse existimo.

LIX.



Praeterea, quia agi jam caeptum est de soni latitudine, non inconueniens erit disserere quare et quomodo sonus per longitudinem trabis in una sui extremitate leniter percussae multo facilius et celerius quam per aërem liberum feratur. Causa hujus rei est ipsa continuitas, quae in trabe multo major est quam in aëre, unde fit ut particulae in momento fere temporis se invicem premere possint. Ut si tangatur trabs BC in puncto B, quia particulae ejus jam se invicem attingunt, sonus ejus in puncto C sine ulla sensibili differentia statim audietur. Si vero moveretur aër juxta B, particulae ejus magis invicem sejunctae cedere possent forsan usque ad E, antequam sonus perveniret ad C. Ille autem motus a B ad E non fieret sine sensibili temporis differentia. Non autem dubium est quin ipsae trabis particulae moveantur. Nam si vel illam terrae imponas, vel panniculo cingas, vel tabulam illi applies, vel alio quocunque modo fixam facias, experimentum non succedet, quia motus particularum statim impeditur.

LX.

Ex hoc eodem fundamento etiam alia perplurima satis jucunda experimenta resolvi possunt. Ut si instrumentum Musicum auribus nostris ita applicaverimus, ut cum illis contiguum quoddam constituat, vel si dentibus illud arripere voluerimus, deprehendemus sonum insigniter nobis adaugeri, unde etiam confirmatur illud quod th. 58 dictum est, vidlicet omnes et singulas instrumenti partes ad motum hunc tremere. Ita si ferream quandam

cylindrical drum (in the vernacular *trumma*) and in the marine trumpet (*trumpet marin*), in which the bridge that is mobile and trembling in one part of itself continuously strikes the sounding table, and increases the sound of the instrument very much and regulates it in different ways. This is also evident in fragments of strings in *violae*, provided that they touch the table, and whatever several other ways there may be. Moreover, in other instruments, and especially in pneumatic ones, such as trumpets, horns, etc., sound is usually notably increased by various roundings, from which the vibrations are reflected in many places and multiplied. This is why such curved instruments are heard at a much longer distance than other ones that are straight. But there is something peculiar as regards the volume in each and every family of instruments. It is not worthwhile to enumerate them all, for I think that they can be easily understood from the general facts that have already been mentioned.

59.



Moreover, since we have already started to do so on volume, it shall not be unfitting to discuss why and how sound is carried much more easily and swiftly through the length of a wooden beam that has been struck gently in one of its outer parts than through open air. The cause of this circumstance is the very continuity, which is much greater in a wooden beam than in air, and this is why the particles can press upon each other almost in a moment of time. If, for example, the beam BC is touched at the point B, since its particles are already in contact with each other, its sound is immediately heard at the point C without any perceptible difference. But if the air would be set in motion close to B, its particles could perhaps, since they are more separated from each other, go all the way to E before the sound would come to C. But this motion from B to E would not take place without any perceptible difference in time. However, there is no doubt that the very particles of the beam move. For if you either put it on the ground, or gird it with rag, or place a table next to it, or make it fixed in any other way, the experiment is not successful, since the motion of the particles is immediately impeded.

60.

From this same foundation several other very interesting experiments can also be explained. If we for example hold a musical instrument to our ears in such a way, that it creates something that is contiguous with them, or if we want to bite it with our teeth, we find that the sound is notably increased for us. Hereby that is also proved which was mentioned in thesis 58, namely that all and each of the parts of the instrument tremble because of this motion. If

perticam vel aliud ex ferro instrumentum vinculo ligaveris ac vinculi extremitates manibus apprehensas ad aures applicueris, in pertica illa pulsata innumeri soni, qui sonos campanarum prorsus imitantur, summa cum delectatione audientur, quorum tamen nullus remotis manibus in aëre libero percipi poterit. Eodem prorsus modo potest sonus per omnia in universum corpora ad maximam saepe distantiam penetrare ac sensus nostros movere, praesertim si aure una bene occlusa alteram terrae dicto jam modo applicueris. Ita audiui milites saepe confessos esse se temporibus belli hac ratione de adventu hostium interdum per aliquot milliaria certo cognoscere potuisse, praesertim si fuissent loca montosa. Dictum etiam est mihi tormenta illa Holmiae in monte Brunconis in certa aëris temperie explosa Upsaliam usque hoc modo audita fuisse. Quod fidei absonum non duco, cum et fateantur Philosophi summi sonum per multo longius spatium penetrare idque per th. 57, et experientia ipsa constet illum hoc artificio melius a nobis percipi posse. Non tamen putandum est sonum aequaliter per omnia corpora perrumpere, sed fieri hoc proportionaliter ad vim moventem et materiae dispositionem.

LXI.

Posset forsitan quis mirari quomodo sonus vitrum sigillatum penetret, de quo actum est th. 55, cum praesertim tam parvi supponuntur vitri pori, ut omnem omnino aërem excludant, et aër tamen sit subjectum soni per th. 4. Hujus autem rei plures dari possunt rationes. Primo, cum sit vitrum illud aliqua alia materia subtiliori, quaecunque demum sit, omnino repletum, ut vulgo Philosophi contendunt, ne vacuum detur, non potest negari motum eundem in hac materia etiam fieri posse atque ab ea per vitrum transferri. Est vero sonus ille debilis et vix sensibilis per th. 9 et 55. Secundo, quia per th. 40 constat vitrum ipsum ex motu sonoro, mediante materia illa subtili, revera tremere, quam ob causam in aërem circumstantem motum hunc a corpore sonoro excitatum quoque transferre potest illumque debilem sonum producere. Tertio, invenio plurimos hujus aevi Philosophos rationibus non contemnendis statuere ipsius etiam aëris particulas longe subtilissimas vitri poros revera penetrare posse, ut accidit cum odor per vitrum sigillatum sentitur et aqua fortis alique liquores interdum vitrum permeant, cumque a sola calce viva vel alia materia pori vitri (ut *Fahlunae* semper fit) ita impraegnantur, ut nulla arte inde eradi possint, et quae sunt alia. Quo

you thus tie some iron rod, or some other instrument of iron, with a cord, and then grab the outer parts of the cord with your hands and hold it to your ears, countless sounds, which completely resemble the sound of bells, are heard with greatest delight in the rod that has been struck. None of these, however, can be perceived in the free air when the hands have been removed. In quite the same way sound can pierce through absolutely all bodies, often at a very long distance, and move our senses, especially if you with one ear entirely closed hold the other to earth in the already mentioned way. Thus I have heard that soldiers have often revealed that they in times of war with this method have sometimes been able to discern for certain the arrival of the enemy at the distance of several miles, especially if the surroundings were rocky. It has even been said to me that explosions of the cannons at Brunkeberg in Stockholm with the air at a certain temperature in this way have been heard all the way to Uppsala. I do not find this unbelievable, since both the foremost philosophers state that sound travels a much greater distance, and this in accordance with thesis 57, and since it is also evident from experience that it can be better perceived by us with this method. One should not think, however, that sound breaks through all bodies equally, but this happens in proportion to the moving force and the structure of the material.

61.

Someone could perhaps be astonished at how sound penetrates sealed glass, with which we dealt in thesis 55, especially when such small pores in the glass are assumed that they exclude all air completely, and since air is nonetheless the subject of sound according to thesis 4. But several explanations of this matter can be given. First, although this glass is completely filled with some other more subtle substance, of whatever kind it may be, as the philosophers generally claim, lest there is a vacuum, it cannot be denied that the same motion can also take place in this substance and be transferred from it through the glass. But this sound is feeble and hardly perceptible, in accordance with theses 9 and 55. Secondly, since it is evident according to thesis 40 that the glass itself readily trembles from the sounding motion, with this subtle substance as the mediator, for this reason it can also transfer this motion that is stirred by the sounding body into the surrounding air and produce this feeble sound. Thirdly, I find that several philosophers of our time, for reasons that should not be despised, state that even the absolutely most subtle particles of the air itself can in fact penetrate pores of glass, as happens when smell is scented through sealed glass, and when nitric acid and other fluids sometimes permeate glass, and when the pores of glass are so impregnated by quicklime alone or some other material (as always happens in Falun), that they cannot be erased from there with any method, and so on. Having conceded this, motion can be imparted also by these particles

concesso etiam per has aëris particulas motus per vitrum aëri circumjacenti communicari potest, et sonus ille debilis elici.

LXII.

Ex hoc etiam fundamento plurimi admirabiles prorsus solvi possunt sonorum effectus, qui passim apud Auctores recensentur. Qualium plurima exempla videre licet apud Danielelem Georgium Marhofium, in *Epistula ad Virum Clarissimum Johannem Danielelem Majorem de schypho vitreo per certum humanae vocis sonum rupto*, ut sunt: *quod in aedibus Musicis vicinis aliquoties collapsum pavementum fuerit ex sonis continuis*, ex Thoma Villisio. *Alicubi in aede sacra fornicem angustiolem, cui substructa erant organa Musica, una cum iis collapsum ob multiplicem soni percussionelem, praesertim cum et ipsi fornices sonare soleant. Non raro tympanorum pulsu et tubarum sonitu templorum fornices concuti. Impetum solum, ut in violenta aëris explosione, et incondito sono ipsis vastissimis aedificiis ac terrae tremorem incutere. Aedificia contremiscere et fenestras frangi, cum tonitru auditur aut bombardae majores exploduntur. Ova, quae aves fovent, eo rumpi vel saltem ita pertubari, ne pulli excludi possint. Ita: Scyphos vitreos, dum in navali praelio exploderentur tormenta, toto illo tempore tremuisse, papyraceas fenestras fissas ac ova, quibus columbae incubabant, confracta. Praeterea: fenestras in sua navi tremuisse, cum exploderetur tormentum in altera tanto intervallo distante, ut visu vix detegi, ac sonus audiri potuerit: Imo: cursum navis suae se mutasse eumque direxisse sono, vel potius motu seu tremore ex sono impresso, cum nihil quicquam audiret. De muris fani ingentis magna pulveris pyrij explosione facta ad 2000 passuum distantiam dissilientibus, et quae sunt caetera, per Digbaeum de natura Corporum, Cap. 28 n. 3. Ad haec: sonum istum adeo movere minimas liquorum vini et cerevisiae particulas, ut fermentantes vitium inde trahant vel alia fermentatione corrumpantur. Cancros tonitru commotos foras prorumpere. Tonitribus terram quati ac rariorem fieri, ut tubera ex imbribus nasci possint, ex Scaligero, exercitatione 180. Foeminae cuidam, cum tonitru audiretur, semper laxatam alvum crebrasque fuisse vomitiones, quales nec a fortissimis effici medicamentis possint, per Oldenburgium in Actis Philosophicis Collegii Regii Angelici, pagina 550. Cervas abortire cum tonitru audiunt, quo sensu etiam plurimi interpretum Psalmorum 29 versus 9 intelligi volunt. Conchas abortum pati ex tonitruum sono, ex Plinio, libro 9 Cap. 38. Aves ex aëre in terram nonnunquam cecidisse et tremuisse ex sono militari, per Alexandrum ab Alexandro Genialium Dierum libro 4, c. 7 etc. Omnia Tauromeni aedificia tremore concussa*

of air through glass to the air that is lying around it, and this feeble sound brought out.

62.

Also from this foundation several quite remarkable effects of sound can be explained, which are examined everywhere by the authors. It is possible to see several examples of this kind in Daniel Georg Morhof's *Epistula ad Virum Clarissimum Johannem Danielem Majorem de schypho vitreo per certum humanae vocis sonum rupto*, for example: 'that the floor had sometimes fallen in from the continuous sounds in buildings situated close to musicians', from Thomas Willis. 'In one place in a church the narrowest vault, under which the organ was built, had fallen in together with the instrument because of the manifold beating of the sound, especially since the vaults themselves usually sound. Not rarely are the vaults of temples shaken because of the beating of drums and sound of trumpets. An impulse alone, as in a violent explosion of air, also causes huge buildings and the earth to tremble by a disordered sound. Buildings quake and windows are broken when thunder is heard, or when bigger cannons are fired. Eggs, which birds brood, are broken because of it, or at least so disturbed, that the chickens cannot be hatched.' Thus: 'cups of glass, while cannons were fired during battles at sea, had trembled all of the time, windows of paper were split, and eggs, on which doves were lying, were broken.' Moreover: 'the windows had trembled on his ship, when the cannon was fired on another at such a distance, that it could hardly be detected with the eyes and the sound heard.' Yes: 'he had changed the course of his ship and directed it by the sound, or rather by the motion or tremble that had been impressed by the sound, since he did not hear anything at all. About the walls of a huge temple that burst asunder because of a great explosion of gunpowder that took place at the distance of 2000 paces', and so on, it is related by Digby in *De natura corporum*, chapter 28, number 3. To this: 'sound moves the smallest particles of the fluids wine and beer so much, that they get defects while fermenting or are destroyed by another fermentation. Tumours that are affected by thunder burst forth to the outside. The earth is shaken by thunder and becomes more porous, so that truffle can appear as the result of rainy storms', from Scaliger, *exercitatio* 180. 'For a certain woman the bowels were always loosened when thunder was heard, and she had frequent vomitings of the kind that could not be caused by the strongest medicines', by Oldenburg, in the *Acta philosophica* of the English Royal Society, page 550. 'Deers miscarry when they hear thunder', in the sense of which several interpreters also want Psalm 29 verse 9 to be understood. 'Oysters miscarry from the sound of thunders', from Pliny, book 9, chapter 38. 'Birds have sometimes fallen from the air to the earth and been frightened by military sound', by Alessandro Alessandri, *Genialium Dierum*, book 4 chapter 7, etc. 'All buildings of Tauromenium were shaken

ex grandi sono et strepitu Aetnae montis erumpentis, qui tamen mons ab urbe ipsa 30 milliaria distabat, ex Borello, prop. 101. Hanc eandem etiam causam esse puto quod, cum alvei apum aestate examinant, ad varios metallorum plausus ac tinnitus statim considant. Ex his facile colligere possumus incredibile non esse quod habet Cartesius in Meteoris Cap. 7: Vehementes sonitus, quales campanarum aut bombardarum, fulminis vim infringere. Nam concutiendo nivem, ex qua nubes inferior constat, illam ad descensum invitat et discutit. Ut ii satis sciunt, qui in vallibus, ubi moles nivium e montibus cadentium timentur, iter facere sunt assueti. Nam ibi ne quidem loqui aut tussire audent, ne sonus vocis nives commoveat. Dixi incredibile non videri, praesertim cum possint soni majores ad majorem distantiam quam est nubium a terra altitudo sensibiliter corpora perrumpere. Nam Varenius in Geographia Generali libro 1 prop. 39 non dubitat certo affirmare nubium altitudinem nunquam deprehensam esse excedere quadrantem milliarias.

LXIII.

Quamvis sonus, ut satis jam dictum est, corpora omnia hoc modo penetret, non tamen tota sua vi ea perrumpit, sed ex magna quoque parte versus loca opposita ab illis reflectitur, quemadmodum radii solares in corpora pellucida impingentes partim per poros se insinuant, partim vero reflectuntur. Etiam si enim dictum sit prius sonum per trabem facilius quam per aërem penetrare, non tamen haec inter sese pugnant. Nam ille ipse motus, qui trabi revera communicatur, etiam per tale medium facilius penetrat. Nihilominus, quia major est trabis soliditas quam aëris, necessario trabs reliquo motui magis resistit, ut omnino reflectatur. Longe enim alia est ratio in medio uniformi quam in diverso. Sicut radii solis facilius quidem penetrant vitrum quam aërem, quamvis vitrum aëre longe sit solidius radiosque per aërem venientes et refringat et reflectat.

LXIV.

Cum sonus hoc modo a corporibus duris reflectitur, nihil quicquam ab iis fere mutatur, nisi quoad solam motus determinationem, vibrationibus interim eodem prorsus modo se habentibus. Hac ratione ubi motus jam duplicatur, vocamus sonum illum reflexum Echo. Nec obstat quod ferantur hae vibrationes in partes sibi invicem oppositas, cum possint eadem particulae pluribus simul motibus inservire per th. 10. Quenam autem objecta esse debeant, quae Echum efficient, perinde est, modo aliquatenus sint regularia et densa. Inter caetera vero omnia primo observandum est

by a quake from the great sound and alarm of the erupting Mount Aetna, a mountain that was, however, at a distance of 30 miles from the town itself”, from Borelli, proposition 101. I think this is also the reason why, when the bees swarm in the summer, they immediately come to rest at the clapping and ringing of different metals. From these facts we can easily deduce that it is not incredible what Descartes touches upon in *Meteora*, chapter 7: ‘Violent sounds, like those of bells or cannons, check the power of the thunderbolt. For by striking against snow, from which we know that the cloud is lower, it urges this to fall and scatters it. As they know well enough who are used to travelling in valleys, where heaps of snow falling from the mountains are feared. For there they do not even dare to speak or cough, lest the sound of the voice shall set the snow in motion’. I said that it does not seem incredible, especially since greater sounds can break through bodies perceptibly at a greater distance than is the altitude of the clouds from the earth. For Varen in *Geographia generalis*, book 1, proposition 39, does not hesitate to assert with certainty that ‘the altitude of the clouds has never been observed to exceed a quarter of a mile’.

63.

Although sound, as has been said enough already, penetrates all bodies in this way, it does not break through them with its entire force, but to a great extent it is also reflected from them towards opposite places. In this way sunrays that collide with transparent bodies partly make their way into them through the pores, but are partly reflected. For even if it was said earlier that sound penetrates a beam more easily than through air, these are not in conflict with each other. For this very motion, which is in fact imparted to the beam, also penetrates such a medium more easily. Nonetheless, since the solidity of the beam is greater than that of the air, the beam necessarily offers more resistance to the remaining motion, so that it is completely reflected. For the principle is quite different in a uniform medium than in a divergent one. In this way do sunrays admittedly penetrate glass more easily than air, even though glass is much more solid than air and both breaks and reflects rays that come through the air.

64.

When sound is reflected by hard bodies in this way, almost nothing at all is changed by them, except that which concerns the mere direction of the motion, since the vibrations meanwhile behave in quite the same way. When motion is doubled according to this principle, we call this reflected sound echo. It is no problem that these vibrations are carried in directions that are opposite to each other, since the same particles are able to be subject to several motions at the same time, in accordance with thesis 10. Of what kind the objects should be that produce echo, that does not matter, if only they are regular and dense to a certain degree. But among all other things it should

fieri semper Echum, ita ut angulus reflexionis aequalis sit angulo incidentiae, unde est quod Echo non semper redit ad corpus sonans, sed alio versus tendit. Quod si vero redierit, necesse est factam esse reflexionem ad angulum rectum. Deinde semper requirit Echo justam objecti distantiam, quae juxta soni velocitatem accurate omnino est eligenda.

LXV.

Si plura talia fuerint objecta in variis a sonante distantis posita, plures Echo una post aliam maxima cum delectatione audientur, ita ut dicat Gassendus in *Philosophia Epicuri* se olim expertum esse *syllabam decies septies redditam esse, imo perhibitum fuisse quibusdam voce validiore redditam etiam vices sexies, prius quam evadens sensim extenuatior audiri prorsus desineret*. Kircherus in sua *Musurgia*, lib. 9, affirmat Echum inter binos muros parallelas *alternis repercussionibus infinitis propagari, donec vox nimia repercussione debilitata tandem deficiat*. Quo in casu etiam soni reflexiones multum impediunt, quod nunquam dantur duo corpora terrae perpendicularia inter sese parallela, ut hic requiritur, si modo ad nos perveniet sonus reflexus. Praeterea tradit Echum, *in qua vocem prolatam vices quater et pro intentione vocis sonitusque amplius, imo in infinitum quasi, multiplicari ajunt*. Ita expertus sum aedes lapideas sibi invicem in foro majori hic Upsaliae oppositas sonum sclopeti tot vicibus reddere, ut sonum in organis tremulum diu exacte imitetur. Est enim spatium illud minus quam ut sonus ibi distincte possit observari. Hoc modo, si quis tam valida praeditus esset voce ac ad hanc distantiam requiritur, posset integram sententiam pronunciare, quae ipsi distincte redderetur.

LXVI.

Ex hac occasione plurima possent adduci de figuris corporum ad Echum aptissimis, ut sunt praeter exacte circulares, Ellipticae et Parabolicae, quae sonos omnes ad suos focos exacte reflectunt, utpote in quibus lineae omnes sonorae maximae diametro figurae sunt aequales. Possent etiam ex his plurima jucunda demonstrari, ut quod habet Kircherus, quomodo chorus alicujus Ecclesiae construendus sit, *ut tres Cantores tantum in illo praestare possint ac centum*. Quod summo jam hoc tempore compendio foret, sed brevitatis causa haec talia ex consulto jam omitto.

first be noticed that an echo always comes about in such a way, that the angle of reflection is equal to the angle of incidence. This is why the echo does not always return to the sounding body, but directs itself in another direction. But if it returns, it is necessary that the reflection is made at a right angle. In addition echo always requires an adequate distance from the object. This should be selected very carefully in proportion to the speed of sound.

65.

If more objects of this kind are placed at different distances from the source of the sound, several echoes are heard one after the other with greatest delight. Thus Gassendi in *Philosophia Epicuri* says that he once experienced that 'a syllable was rendered ten times seven times, yes it had been shown by some people that it with a stronger voice was rendered even twenty times six times, until it gradually faded and was reduced and quite ceased to be heard.' Kircher in his *Musurgia*, book 9, asserts that echo between two parallel walls 'is spread out in endlessly alternating reflections, until the voice is weakened through too much reflection and finally ceases.' Also in this case much impedes the reflections of sound, since two bodies that are vertical in relation to earth and parallel with each other never appear, and this is required here, if the reflected sound shall come all the way to us at all. Moreover, he speaks about an echo, 'in which they say that an expressed voice is multiplied twenty times four times, and even more depending on the intensity of the voice and the sound, yes even as good as endlessly'. Thus I have experienced that stone houses lying opposite to each other at the great square here in Uppsala return the sound of a gun so many times, that it for a long time exactly resembles the trembling sound in organs. For that space is so small that sound cannot be observed distinctly there. In this way, if anyone would be gifted with such a strong voice as is required for this distance, he would be able to pronounce an entire sentence that would be returned distinctly to him.

66.

From this occasion more could be adduced about figures of bodies that are very suitable for echo, for example, besides the exactly circular, there are elliptical and parabolic ones, which reflect all sounds exactly to their focal points, since all lines of sound in these are equal to the greatest diameter of the figure. Several delightful circumstances could also be explained from these facts, as that which Kircher relates, how the sanctuary of any church should be built, 'so that three singers can achieve as much in it as hundred'. This would be of great benefit in these days, but for the sake of brevity I now deliberately omit these matters.

LXVII.

Sunt et alia multa particularia experimenta de Echo, in quibus differentiam aliquam invenire licebit ex locis ipsis unde reflectitur sonus, ut a Mersenno observatum video ex *Cartesii Epistula* 92, part. 2, quod nimirum locum notasset, qui fere non nisi duos tonos sexta inter sese distantes, ut est inter *c* et *a*, continuo reddebat. Sed hujus ratio infra patebit.

LXVIII.

Dictum est hactenus de soni profunditate ac latitudine cum ejus differentiis et effectibus variis, superest vero jam ut de ejusdem longitudine nonnulla exponam. In longitudine soni venit tempus considerandum, quo eum juxta certam mensuram metimur. Illa mensura vocari solet tactus. Quia vero sensus nostri ea facilius percipiunt, in quibus minor est partium differentia, ideo tactus partibus aequalibus, quae proportionem vel duplam vel triplam inter sese habent, semper constare debet. Nam est proportio haec omnium simplicissima et sensibus maxime obvia. Ex hac temporis mensura duplex oritur tactus, Spondaicus et Trochaicus, nec ulterius fit progressio. Certum quidem est in illis instrumentis, quae semper eundem sonum reddunt, ut sunt tympana et castanetae, non solum hanc proportionem duplam et triplam observari, sed ejus tactum in 5 aut forsitan 7 partes dividi solere. Sed quia sensus in illis instrumentis ad nihil aliud attendunt quam ad hos solos pulsus, etiam eos melius possunt observare majoremque temporis varietatem admittere. In reliquis autem instrumentis, in quibus soni differentia secundum trinam dimensionem est attendenda, haec nunquam fiunt, nec unquam ultra dictam proportionem duplam vel triplam fit progressus. Quamvis enim notulae in plurimas alias saepissime resolvantur, ut fit in Musica diminuta, manet tamen semper eadem revera proportio. Sicut numeri indefinite inter sese hac ratione multiplicari possunt, hi tamen numeri non sunt inter sese primi, sed ex primis multiplicati. Notum enim est quam multas triplae differentias cum variis suis numeris Musici Practici jam soleant adhibere, sed eadem tamen est earum proportio in numeris hisce multiplicatis, puta vel tripla vel sesquialtera. Verum, cum nego proportionem esse diversam, non tamen nego aliquos alios in nobis motus per diversarum specierum triplas oriri posse, qui non tam speciebus triplarum, quam diminutioni valoris in notulis adscribendi videntur. Nullam enim aliam in his differentiam invenire possum. Hinc ratio est manifesta, quare nullus unquam numerus triplae possit praeponi, qui non sit exacte divisibilis in duas vel tres partes aequales, ut et quod si numerus superior dividi possit in partes tres,

67.

There are also many other specific experiments about echo, in which it is possible to find a certain difference depending on the very places from where sound is reflected. I see that this is observed by Mersenne in 'letter to Descartes' no. 92, part 2, since he had evidently noticed a place, which continuously rendered almost nothing but two tones at the distance of a sixth from each other, as it is between *c* and *a*. But the explanation of it shall be elucidated below.

68.

We have so far been speaking about the pitch and volume of sound with its different variants and varying effects, but now it remains for me to present some facts about its duration. In the duration of sound the time must be considered, with which we measure it according to a certain measure. This measure is usually called *tactus*. But since our senses perceive this more easily, in which there is a smaller difference between the parts, *tactus* must always consist of equal parts, which are either in a duple or triple proportion to each other. For this proportion is the simplest and most obvious to the senses of all. From this measure of time a twofold *tactus* comes about, the spondaic and the trochaic, and there is no progression further. Admittedly it is certain that in those instruments, which always render the same sound, for example drums and castanets, not only this duple and triple proportion is observed, but its *tactus* is usually divided into five or perhaps seven parts. But since the senses pay attention to nothing in these instruments other than the beats, they can observe them even better and allow a greater variety of time. In the remaining instruments, however, in which one must pay attention to the different characteristics of sound according to its three dimensions, this never happens, and there is never a progression beyond the mentioned duple or triple proportion. For although notes are very often separated into several others, as happens in figurate music, the same proportion in reality always remains. Although numbers can be multiplied endlessly in relation to each other with this method, the numbers are not primes in relation to each other, but multiplied from the primes. For it is well known how many different variants of the triple proportion with its different numbers musical practitioners usually apply, but their proportion in these multiplied numbers is nevertheless the same, that is either triple or sesquialter. However, although I deny that the proportion is different, I do not deny that any different motions can come about in us through triples of different species. These must seemingly be ascribed not so much to the species of the triples, as to the diminution of the value in the notes. For I can find no other difference in them. Hereby the explanation is manifest, why no number of the triple can ever be placed in the front, which is not exactly divisible in two or three equivalent parts, as well as that if the

erunt tres etiam tactus partes, si vero in duas, constabit et tactus ex partibus duabus, et quae sunt reliqua.

LXIX.

Quam necessarius sit in Musica tactus et quantum nostram imaginationem in Cantilenis adjuvet, notius est quam ut ulterius exponatur. Maxime vero ejus vis apparet in Cantilenis, ad quarum sonum saltare solemus. Ibi enim singulis cantilenae partibus singuli corporis motus exacte respondent. Quod facile norunt omnes in hac arte edocti, ita ut si justa temporis mensura non observetur, ad ejus pulsum non nisi maxima cum difficultate saltare possimus. Est enim hoc omnibus ita naturale, ut non solum infantes et alii quantumvis rudes, sed etiam bruta ipsa hoc nonnunquam teste Kircherō possint observare. Ratio autem haec est: Cum fiunt vibrationes illae ac tremuli in aëre, de quibus saepe dictum, certum est motum hunc omnia circumquaque corpora ratione suae vehementiae magis magisque concutere per th. 62. Ad hunc eundem ergo motum etiam spiritus, quorum beneficio omnes motus corporei peraguntur, facile ad motum incitantur, unde oritur illa titillatio, quam in nobis ad pulsum instrumentorum sentire solemus, praesertim cum corpus vino sublevatum est spiritibusque gaudet vividioribus ac subtilioribus. Posito ergo hominem sanum, hilarem ac potu mediocriter reffectum esse, dico quod in praesentia Concentus Musici a saltu se vix abstinere possit. Quamvis enim continuo alias ob causas non saltet, vix tamen ita quiescet quin pulsui instrumentorum alicujus sui corporis partis motu exacte respondeat.

LXX.

Praetera, cum pulsantur nervi vel chordae, singuli pulsus fortius in initio quam in fine sonant per th. 44 et 19, donec omnino sonus evanescat, et prout sonus intenditur et remittitur. Ita etiam spiritus ipsi per vices vehementius et lentius ad motum per totum corpus impelluntur. Quia itaque haec soni differentia in pneumaticis instrumentis fieri non potest, sed tantum in Polyplectris per th. 32, facile apparet quare instrumenta illa ad saltus movendos his minus apta sint, quod omnium clarissimum est ex instrumento illo vulgari *Regal* dicto. Unde non sine ratione fit, quod arcus fidium in Choreis pulsandis interdum paululum eleventur, praesertim in initio tactuum ubi puncta ut plurimum occurrunt, ut scilicet eorum inter se pulsus melius observari possint. Etiam facile hinc apparet quod vice versa instrumenta pneumatica polyplectris in Musica vocali longe sint commodiora, praesertim ad fundamentum seu Bassum generalem pulsandum, quia cum vibrationum

upper number can be divided into three parts, there are also three parts of the *tactus*, but if into two, also the *tactus* consists of two parts, and so on.

69.

How necessary *tactus* is in music and how much it nourishes our fantasy in songs, is too well known to be further explained. But its force is most evident in songs, to the sound of which we usually dance. For there each and every motion of the body corresponds exactly to each part of the song. All who are educated in this art know that for certain. In consequence, if the correct measure of time is not observed, we cannot dance to its beats but with greatest difficulty. For this is so natural to all, that not only infants and others, how ignorant they may ever be, but even the very animals can often notice it, as Kircher testifies. The explanation is this: when these vibrations and trembles come about in the air, about which we have spoken many times, it is certain that this motion shakes all bodies all around it more and more in proportion to its fervency, in accordance with thesis 62. To this same motion also our spirits, thanks to which all bodily motions are performed, are thus easily excited into motion. Hereby this titillation comes about, which we usually sense in us at the beats of instruments, especially when the body is alleviated with wine and enjoys more vivid and subtle spirits. Having thus posited a man in good health that is happy and slightly revived from drinking, I say that he can hardly refrain from dancing in the presence of a musical consort. For although he does not dance all the time for different reasons, he hardly falls so much to rest that he does not respond exactly to the beats of the instruments with the motion of some part of his body.

70.

Moreover, when strings or chords are struck, each and every strike sounds more strongly at the beginning than at the end, in accordance with theses 44 and 19, until the sound completely fades away, and accordingly as the sound is made higher and lower. Likewise also the very spirits are alternately set in motion more violently and slowly in the entire body. Since this diversity of sound cannot take place in pneumatic instruments, but only in polyplectrum instruments, in accordance with thesis 32, it is thus very evident why the former instruments are less suited than the latter to inciting dances. This is most evident of all in the instrument called *Regal* in the vernacular. Hereby it does not happen without reason that the bows of fiddles are sometimes slightly lifted up in the playing of dances, especially at the beginning of the *tactus* where the dots occur most often, certainly in order for their beats to be able to be better observed in relation to each other. Hereby it is also very evident that pneumatic instruments are conversely much more suitable than polyplectrum instruments in vocal music, especially for playing the *basso-part* or the *basso continuo*, since they are in better concord with each

differentiae in vocibus neque fiant neque observari possint, melius igitur inter sese concordant. Hoc etiam confirmabitur si modo consideremus quam multum hic motus promoveatur et nos per consequens magis ad saltum incitemur, si reliquis instrumentis etiam jungantur castanetae vel tympana. Quamvis enim in his nulla alia sit soni varietas, quam quod ad justam cum reliquis mensuram exacte pulsantur, hoc ipso tamen fit ut pulsus, juxta quos ducitur chorea, magis distincti ac observabiles reddantur. Facile etiam hoc intelligi poterit, si reputetur quomodo ex sola pulsuum horum celeritate aut tarditate varii saltandi modi sint inventi, ut alii apud Svecos, alii apud Gallos, et alii apud Polonos, etc., usurpentur. In quibus modis proportionem triplam, qua utuntur Politiores a plebeiis diversa in chorearum saltu secundo, juvabit etiam considerare, et quam diversi corporis motus ex hac sola varietate necessario sequantur. Adeo ut qui modo priori in saltando assuetus sit, ad modum ludendi secundum seu plebejorum vix possit saltare. Si autem aliqua ratione id facere cogatur, etiam corporis motus ad mensurae differentiam omnino variabit.

LXXI.

Hactenus sonum generaliter tantum in se consideravi. Restat jam ut Consonantias et Dissonantias ex duobus sonis inter se collatis exortas breviter exponam. Non autem putandum est unum sonum ex se esse vel consonum vel dissonum, sed esse hoc tantum respectivum ad alium sonum et ad sensus nostros, ita ut nullus cum uno dissonet, qui non cum alio consonet. Ut autem res evidentior evadat, apponam primo consonantias primarias earumque proportionem inter sese in numeris minimis et radicalibus, ut est:

Octava ut -- 2 ad 1.

Quarta -- 4 -- 3.

Tertia minor -- 6 -- 5.

Sexta minor -- 8 -- 5.

Quinta ut -- 3 ad 2.

Tertia major -- 5 -- 4.

Sexta major -- 5 -- 3.

Consonantias autem compositas supra Octavam omitto. In illis enim eadem est ratio ac in simplicibus, modo numeri multiplicentur.

other, since different variants of vibration can neither come about nor be observed in voices. This is also proved if we only consider how much this motion is promoted and how we are consequently more incited to dancing, if also castanets or drums are united with the other instruments. For although there is no other variety of sound in these, than that they are struck exactly at a right measure with the others, this is precisely why the beats, according to which the dance is lead, are rendered more distinct and more possible to be observed. This can also be easily understood, if one considers how different kinds of dancing have been invented merely from the speed and slowness of these beats, so that some are practiced among the Swedes, others among the French, and others among the Poles, etc. In these kinds it is also useful to consider the triple proportion, which more refined people use differently from base people in the second leap of the dances, and how different movements of the body necessarily follow merely from this variation. In consequence the one who is accustomed to the previous way of dancing, is hardly able to dance to the second, or the base people's, way of playing. But if he is forced to do this for some reason, he changes his body's movements completely according to the different measure.

71.

I have so far considered sound in general terms merely in itself. Now it remains for me to briefly treat consonances and dissonances arisen from two sounds that are combined with each other. One should not, however, think that one sound is either consonant or dissonant in itself, but that it is so only in relation to another sound and to our senses, so that none is dissonant with one, which is not consonant with another. In order for the subject to become clearer, I shall first attach the primary consonances and their proportions in relation to each other in numbers that are as small as possible and roots, as:

The octave as 2 to 1.

The fourth as 4 to 3.

The minor third as 6 to 5.

The minor sixth as 8 to 5.

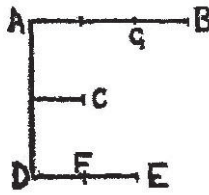
The fifth as 3 to 2.

The major third as 5 to 4.

The major sixth as 5 to 3.

The compound consonances above the octave I leave out of account. For in them the principle is the same as in the simple ones, provided that the numbers are multiplied.

LXXII.

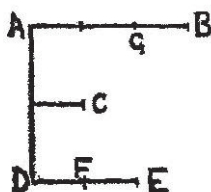


In superioribus saepius monstratum est nervum unum cum altero duplum etiam suas vibrationes ratione dupla necessario peragere, et ita in reliquis omnibus, servata cujusque proportione. Has proportiones exprimunt numeri hi appositi pro unaquaque consonantia. Ita octava se habet ratione dupla ut 2 ad 1, cujus vibrationes etiam sunt inter sese duplae, etc. Itaque si dividatur linea exempli gratia DE in duas partes aequales, ut est ad F vel C, faciet linea DE et DF inter se Diapason, ut est 2 ad 1. Si dividatur AB in tres partes, fiet inter AG et AB quinta, ut est 3 ad 2, et ita in omnibus pro cujusque intervalli ratione. Dico ergo quod, si DF et DE simul moveri incipiant, dum DE faciet unam, habebit DF exacte duas vibrationes. Et dum AB semel, DE semel cum dimidio recurret. Itaque cum AB incipit suam secundam vibrationem, inchoabit C suam quartam, et DE suam secundam dimidiam. Deinde cum AB instituit suam tertiam, iterabit C suam septimam, et DE suam quartam vibrationem, atque ita in reliquis. Cum itaque vibrationes hoc modo in aliquibus suis momentis exacte conveniunt, faciunt in nobis concentum, quem consonantiam communiter appellare solemus.

LXXIII.

Cum vero contra vel nunquam vel rarissime exacte inter sese conveniunt vibrationes istae, tunc motu suo irregulari aures nostras magis feriunt atque ita dissensum quendam nobis praebent. Detractis autem Consonantiis, quae satis paucae sunt, facile constat omnes reliquas tremulorum inaequalites motum dissonum in nobis producere, quem dissonantiam vocamus, quarum omnium nec proportio nec numerus exprimi potest, sed revera sunt et incommensurabiles et indefinitae.

72.

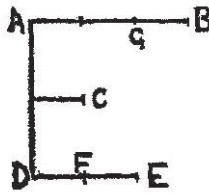


It has been shown many times above that one string that is duple in relation to another necessarily also performs its vibrations in a duple proportion, and likewise in all other cases, when the proportion of each one has been preserved. These attached numbers express the proportions for each and every consonance. Thus the octave is in a duple proportion as 2 to 1, the vibrations of which are also duple in relation to each other, etc. If therefore for example the line DE is divided in two equal parts, as it is at F or C, the line DE and DF brings about a diapason in relation to each other, as it is 2 to 1. If AB is divided into three parts, there is a fifth between AG and AB, as it is 3 to 2, and likewise in all cases in proportion to each and every interval. Thus I say that, if DF and DE begin to move at the same time, while DE produces one, DF has exactly two vibrations. And while AB recurs once, DE does so once and a half. When therefore AB starts its second vibration, C begins its fourth, and DE its second and a half. When AB thereafter sets about its third, C repeats its seventh, and DE its fourth vibration, and likewise in other cases. When the vibrations therefore come together exactly in this way in some of their moments, they bring about a concord in us, which we in general usually call consonance.

73.

But when these vibrations on the contrary either never or very rarely are in exact concord with each other, then they strike our ears more with their irregular motion and thus they cause a kind of discord in us. But when the consonances have been removed, which are few enough, it is very evident that all remaining inequalities of the vibrations produce a dissonant motion in us, which we call dissonance. Neither the proportion nor the number of all of these can be expressed, but they are really both incommensurable and unlimited.

LXXIV.

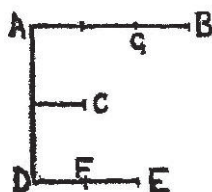


Ex his satis perspicuum est quatenus ex Consonantiis magis vel minus perfectae ac simplices sint, prout videlicet vibrationes earum saepius conveniunt, et minoribus numeris radicalibus gaudent, ut exempli gratia Octava, quinta et duodecima, quae omnium simplicissimae sunt, et numeris minimis 1 2 3 exprimuntur. Quia igitur dum AB semel recurrit, C exacte ter, sed DE non nisi semel cum dimidio redit, in hoc momento statim convenit C cum AB, non vero DE, nisi in proxime sequenti recursu nervi AB. C autem consonat cum AB per duodecimam, sed DE per quintam. Ideo sequitur duodecimam quinta esse perfectiorem et simplicior. Sic sexta minor non nisi in nono suarum vibrationum momento cum octava convenit, id est cum illa 8 et haec 5 praecise vibrationes absolvit, unientur in proxime sequenti recursu. Hic calculus ad reliquas omnes consonantias facile applicari potest, modo uniuscujusque proportio observetur.

LXXV.

Hoc est fundamentum ex quo una Consonantia altera perfectior ac simplicior esse demonstratur. Ex qua Consonantiarum natura Practicus ingeniosus plurimas Regulas in gratiam Compositionum Musicarum eruere posset, quatenus nimirum Consonantiae alteras in melodia sequi debeant, et quatenus in quolibet modo Musico aptius adhibeantur tam in lugubribus quam amoenis Cantilenis. Cujus experimentum nobis exhibet Cartesius in Epistula quadam ad Mersennum, ubi scribit se proportionem intervallorum Musico cuidam Practico hoc modo demonstrasse. Qui postquam illa satis bene intellexit, saepius dixit: *se melodias postea ferre non potuisse in quibus distinctio observata non sit inter tonum majorem et minorem*. Quam bene autem a Musicis haec talia jam observentur, meum non est inquirere. Sunt tamen quaedam maxime generalia, quae facile a quovis observari possunt, ut tertia major et minor ad differentiam praecipue melodiae amaenae ac lugubris. Ex cujus varia collocatione duodecim illi modi Musici maxime usitati oriuntur.

74.



From these circumstances it is perspicuous enough which of the consonances are more or less perfect and simple, namely in proportion as their vibrations are more often in concord, and have smaller root numbers, as for example the octave, the fifth and the twelfth, which are the simplest of all and expressed with the very small numbers 1 2 3. Thus, while AB recurs once, C does so exactly three times, but DE only returns once and a half, C at this moment is immediately in concord with AB, but not DE, if not in the most closely following movement back of the string AB. C, however, is consonant with AB at the twelfth, but DE at the fifth. Therefore it follows that the twelfth is more perfect and simple than the fifth. So the minor sixth is not in concord with the octave but in the ninth moment of its vibrations, i. e. when the former releases exactly 8 and the latter exactly 5 vibrations, they are united in the most closely following movement back. This calculation can easily be applied to all remaining consonances, provided that the proportion of each and every one is observed.

75.

This is the foundation from which one consonance is proved to be more perfect and simple than another. From this nature of consonances a gifted practician would be able to elicit several rules to the benefit of musical compositions, namely which consonances should follow others in a melody, and which are more suitably applied in any musical mode both in gloomy and in delightful songs. An experiment into this matter Descartes displays for us in a certain letter to Mersenne, where he writes that he has demonstrated the proportions of the intervals for a certain musical practician in this way. This man, when he had understood this well enough, very often said that: 'he thereafter had not been able to stand melodies in which the distinction between the major and minor tones was not observed.' It is not my task to investigate how well such things are already observed by musicians. But there are some very general circumstances that can be easily observed by anyone, for example the major and minor third for the difference especially between the delightful and the gloomy melody. From its varying position those twelve musical modes that are most used are created.

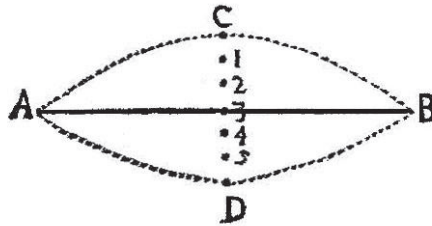
LXXVI.

Sed notandum est me in th. 74 dixisse facile demonstrari posse quaenam consonantiae aliis sint simpliciores ac perfectiores, non vero dixisse absolute posse determinari quaenam aliis sint gratiores ac jucundiores, quia hoc tantum ad nostrum iudicium respectum habet, quod in singulis fere hominibus diversum est. Ita alii magis una voce sola quam concentu, alii magis ex tristibus Cantilenis quam ex amaenis, et contra alii magis hoc instrumento, alii alio delectantur. Quam vocem etiam unus hilarem iudicat, alter lugubrem saepe appellat. Imo, idem homo pro diversa ratione loci, personae aetatis, instrumenti aliorumque praejudiciorum, Cantilenam eandem modo hilarem modo tristem pronunciat, ita ut vix aliquid certi determinari posse putem, sicut plures olivis vel aceto magis delectantur quam saccharo vel vino, quamvis nullus neget esse saccharum et vinum, olivis ac aceto et suavius et dulcius.

LXXVII.

Ex his jam facile redditur ratio, quare in concentu Musico quantumvis completo, si unus sonus a reliquis dissonet, ejus vox prae omnibus caeteris vehementissime audiat. Quia enim omnium reliquarum vocum soni in aliquibus vibrationum momentis inter sese conveniunt, ideo aures nostras cum magna discrepantia non feriunt. Hujus vero vox, quia vel rarissime vel nunquam cum reliquis unitur, aures non nisi cum molestia tangit, et mentem quasi cogit ut ad se praecipue attendat.

LXXVIII.



Quia mentio quoque facta est dissonantiarum, paucis rationem adducam, quomodo et quare corpora quaedam tam falsum sonum edant, ut nullo saepe usui esse possint, quod praecipue observamus in nervis. Causa est aliqua partium inaequalitas in nervo, cum videlicet non est in omnibus vel aequae crassus vel aequae densus. Cum enim est nervus inaequalis, habebunt partes hae densiores motum quendam alium a toto nervo diversum, ita ut fiant duo simul tremorum genera. Ut exempli gratia sit nervus AB, qui feratur a C versus D, sit vero

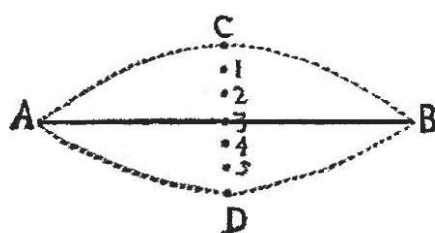
76.

But it should be noticed that I said in thesis 74 that it can be easily proved which consonances are simpler and more perfect than the others, but I did not say that it can be absolutely determined which are more delightful and pleasant than others, since this depends only upon our own judgment, which is different in almost each and every man. Thus some are more delighted by only one voice than by a choir, others more from sorrowful songs than from delightful ones, and the contrary, some from this instrument, others from another. The voice that one thinks is merry, another often calls sorrowful. Yes, one and the same man, depending on the different characteristics of the place, of the man's age, of the instrument and of other prejudices, claims that the same song is now merry, now sorrowful. Thus I think that hardly anything certain can be determined. In this way are many people more delighted by olives or vinegar than by sugar or wine, although nobody denies that sugar and wine are both more pleasant and sweeter than olives and vinegar.

77.

From this an explanation is easily rendered, why in a musical consort that is perfect to any possible degree, if one sound is dissonant with the others, its voice is strongly heard above of all others. For since the sounds of all other voices are in concord with each other in some moments of the vibrations, they do not strike our ears with a great discrepancy. But the voice of this one, since it is either very rarely or never united with the others, does not touch the ears but with disgust, and forces the mind, so to speak, to pay attention especially to it.

78.



Since mention was also made about dissonances, I shall adduce the reason in a few words how and why some bodies emit so false a sound, that they often cannot be of any use. We especially observe this in strings. The cause is a kind of irregularity of the parts in the string, since it is namely neither equally thick nor equally dense in all parts. For since the string is irregular, the denser parts have another kind of sound that is different from the entire string, so that there are two kinds of trembles at the same time. Let there for example be a string AB, which is carried from C towards D, but let there be

in puncto ejus medio nodus quidam – quod frequentissimum est in nervis – qui ratione suae molis ac quantitatis densior sit reliquis nervi partibus. Quo posito satis constat illum etiam majorem ad sese agitationem recipere posse per th. 9. Dum itaque fertur totus nervus a C ad D, statim ac nodus pervenit exempli gratia ad 2, retrahet se versus 1, quia non potest ultra nervum ipsum moveri, quaemadmodum faciunt naves anchoris deligatae, deinde ab 1 versus 3, rursusque redibit ad 2, postea a 2 ad 4, et a 3 ad 5. Ita ut eodem tempore quo totus nervus unam facit vibrationem communem a C ad D, punctum illud plurimas alias minores absolvet, ut sunt C, 2:1, 3:2, 4:3, 5:4, D. Quae vibrationes, quia cum toto nervo et sono ejus naturali non conveniunt, juxta superius dicta, sonum edent a toto nervo prorsus dissonantem. Eadem est ratio si nervus in aliqua sui parte fuerit vel tenuior vel mollior, tunc enim contrario fiet modo, ita ut possint hae vibrationes pro varia nervi constitutione tot modis inter sese variari, quot sunt et motus gradus et puncta inter C et D. Hunc motum nervorum irregularem etiam unusquisque videre poterit, si nervus mediocriter inter manus tensus digito pulsetur. Quod Practicis notissimum est in nervis eligendis.

LXXIX.

Si contingat has vibrationes cum toto nervo convenire, juxta modum in th. 74 traditum, nervus sonum duplicem inter sese consonantem simul perficiet. Sed quia diversitas haec secundum omnia puncta potest indefinite mutari, rarissime hoc eveniet, dissonabunt autem frequentissime. Haec est ratio ac causa omnis dissonantiae in quocunque instrumento. Nam in tibiis, quamvis ipsum instrumentum non tremat per th. 21, potest tamen alias inaequalites et asperitates habere, quibus aëris tremores mutantur. Unde etiam exhinc constat quam exiguum esse possit momentum, quod impediat quo minus aequè perfectum ab eodem artifice semper confici possit instrumentum.

LXXX.

Sunt praetera plurimi consonantiarum ac dissonantiarum in aliis corporibus effectus satis mirabiles, quos hac occasione prorsus praetermittere non possum. Ex illis autem uno explicato caeteri satis manifesti erunt. Longe frequentissimum et cuivis obvium est chordam unam pulsata etiam aliam intactam in longa satis distantia ad sonum impellere. Sed hoc non fit nisi perfectissima inter sese consonantia concordent, ut praecipue in octava. Ratio autem haec est: cum nervus pulsatur, magnam habet vim ratione suae vehementiae ad reliqua circumquaque corpora etiam movenda,

some kind of node in its very middle point – this occurs very frequently in strings – which is denser than the other parts of the string as regards its mass and quantity. This being posited, it is very evident that it can also receive a greater movement in itself, in accordance with thesis 9. While therefore the entire string is carried from C to D, as soon as the node for example reaches 2, it draws itself back towards 1, since it cannot move beyond the string itself, like ships that are tied up with anchors, then from 1 towards 3, and again it returns to 2, then from 2 to 4, and from 3 to 5. In consequence, in the same time as the entire string produces one common vibration from C to D, this point releases several other minor ones, for example C, 2:1, 3:2, 4:3, 5:4, D. Since these vibrations are not in concord with the entire string and its natural sound, in accordance with the abovementioned, they emit a sound that is completely dissonant from the entire string. The explanation is the same if a string is either tenderer or softer in any of its parts, for then it happens in the opposite way, so that these vibrations can vary in so many ways in relation to each other, in proportion to the varying constitution of the string, as there are degrees of motion and points between C and D. Each and everyone can see this irregular motion of the strings, if a string that is somewhat stretched between the hands is struck with a finger. This is very well known to practitioners when they select strings.

79.

If it occurs that these vibrations are in concord with the entire string, in accordance with the way that was related in thesis 74, the string brings about a twofold sound that is mutually consonant at the same time. But since this diversity can change endlessly along all points, this happens very rarely, but very frequently are they dissonant. This is the reason and the cause of every dissonance in an instrument of any kind. For in flutes, although the instrument itself does not tremble, in accordance with thesis 21, it can have other irregularities and harshnesses, by which the trembles of the air change. Also from these facts it is evident how tiny the influence can be that impedes that an instrument can always be made equally perfect by one and the same craftsman.

80.

There are furthermore several effects of consonances and dissonances in other bodies that are wonderful enough, which I cannot pass over completely on this occasion. When one of them has been explicated, the others shall be clear enough. Absolutely most frequent and obvious to everyone is that one string that has been struck also sets another untouched one in motion to sound at a very great distance. But this does not happen unless they are in concord in a perfect consonance in relation to each other, as especially at the octave. The explanation is this: when the string is struck, it has a great power in proportion to its fervency also to move the other bodies all around it,

per th. 62. Si ergo in aliud corpus sonorum ac proportionatum hic motus impingat, ut exempli gratia in nervum alium, illum facile ad motum impellit. Si ergo alter hic nervus per Diapason a priori distet, vibrationes illorum optime inter sese convenient, per th. 72, ut sese invicem juvent in motu, unde est quod his positis unus nervus ad pulsum alterius facile resonet. Sicuti tubas comperimus longius audiri cum adsint tympana, et violas longius una cum violis majoribus quam alias solas. Quod si vero vel alia consonantia minus perfecta, vel etiam dissonantia quadam unus nervus ab altero distet, hoc ipsum vel non tam facile, vel etiam nullo modo succedet. Cum enim nervi inter sese dissonent, vibrationes eorum, quia nunquam inter sese conveniunt, se invicem potius impediunt. Unde est quod hoc in casu nervus alter vel prorsus quiescat, vel ad minimum non resonabit. Sed est notandum quod, si longe maxima vis movens adhibeatur, ut si instrumentum ipsum in campanisterio collocaretur, tunc omnes totius instrumenti chordae, tam dissonantes quam consonantes, facile sonum efficerent. Hinc est quod si fistulam ad manuchordium inflare volueris, illa chorda, quae ad eundem tensa est sonum, etiam resonabit, caeterae vero non itidem. Eodem modo etiam ad pulsus horae chorda clavechordii eidem sono respondens in conclavi resonabit.

LXXXI.

In hujus rei majorem illustrationem exempla quaedam praeclara ex auctoribus adducam, ut ex Kircheri in *Musurgia* l. 9, c. 7: *Contingit subinde ut multis colloquentibus una quaequam vox scamna tremere faciat reliquorum vocibus nihil in ea imprimentibus. Notavi quoque subinde unam fistulam alicujus Organi chordam certam chelis majoris tam acriter commovisse, ut plectro vibrissata videretur. Ingentis quoque molis lapidem semper tremuisse ad sonitum certae fistulae organi, hac vero silente et reliquis sonantibus nihil commotionibus fuisse perceptum.* Et ex Mersenno, qui refert apud Franciscanos Parisienses: *quoque id mirum scilicet, dum organa pulsantur, pavimento ita concuti, ut ferme verearis ne terra dehiscat, quod tamen minime sentis, si vel propius ad Organa accedas vel ab eis longius recedas. Hoc eodem pacto ad catadupas Tyburtinas annulus quidam ferreus domui vicinae insertus spectatur vehementi cadentis fluminis sonitu perpetuo mobilis, etc.* Item ex Epistula Marhofij de scypho vitreo per certum humanae vocis sonum rupto, quem inquit: *explorato primum vitri tono mihi tenendum porrigebat, oreque mediae parti admoto, voce quae Diapason vitri superabat tonum insonabat,*

in accordance with thesis 62. If thus this motion strikes into another sonorous and proportioned body, as for example into another string, it easily sets this into motion. If thus another string is here at the distance of a diapason from the first one, their vibrations concord very well with each other, in accordance with thesis 72, so that they support each other in the motion. This is why, when these facts have been posited, one string easily resounds at the strike of another one. Thus we notice that trumpets are heard at a greater distance when drums are present, and *violae* at a greater distance together with larger *violae* than otherwise when they are alone. But if one string differs from another either in another consonance that is less perfect, or even in some dissonance, this very thing follows either not so easily, or in no way at all. For since the strings are dissonant in relation to each other, their vibrations, since these are never united with each other, rather impede each other. This is why in this case the other string is either completely at rest, or at least it does not resound. But it should be noticed that, if a very strong moving force is applied, for example if the instrument itself should be placed in a bell tower, then all strings of the whole instrument, both dissonant and consonant ones, would easily produce sound. This is why, if you wish to inflate a pipe together with a manichord, the string that is stretched to the same sound also resounds, but the others not in like manner. Likewise, at the stroke of the hour the string of the clavichord that responds to this sound also resounds in the room.

81.

For a better clearness of this matter I shall adduce some splendid examples from great authors, for example from Kircher's *Musurgia*, book 9, chapter 7: 'It happens frequently that only one voice of some kind makes benches tremble among many who are talking to each other, while the voices of the others make no impression upon it. I have also often noted that one pipe of a certain organ has affected a certain string of a bigger *chelys* so strongly, that it seemed to have been trilled by a plectrum. A stone of great weight has also always trembled at the sound of a certain organ-pipe, but when it was silent and the other ones sounded nothing was perceived from the commotions.' And from Mersenne, who relates that among the Franciscans in Paris: 'namely also this thing is remarkable, that while organs are played, the floor is shaken so much, that you almost fear that the earth splits open, which you nevertheless by no means feel, if you either go closer to the organ or go farther back from it. In this same manner at the Tiburtine cataracts a certain iron ring that is attached to a house nearby can be seen, which is mobile because of the eternal violent sound of the falling river, etc.' Likewise from Morhof's letter about a cup of glass that was broken by a certain sound of a human voice, which he says: 'when the tone of the glass had first been investigated, he held it forth for me to hold it, and having moved his mouth to its middle part, with the voice he sounded a tone that exceeded the

consonabat statim vitrum pene ad stridorem usque, et tremorem ejus manus mea sentiebat. Quam cum ille vocem non interruptam longo pneumate continuaret, cum strepitu rumpebatur vitrum. Praetera: saepe mihi visus sum tremorem deprehendere in sedili ligneo, in quo mihi adsidebat alius, in mensa etiam ipsa, cui innitebatur cum loqueretur aliquo tono, quod, cum alius eodem in sedili sedens diverso tono loqueretur, non fiebat. Sensi non semel in conclavi aliquo tremorem sub pedibus, cum stringerentur certae quaedam chordae Pandurae majoris, quem non sentiebam, cum aliae stringerentur. Haec ille. Et quae sunt alia innumera, quae unusquisque per se facile explorare poterit. Ratio autem est non nisi vibrationum vel aequalitas vel convenientia, ut motum talem in se recipere possint.

LXXXII.

Haec eadem ratio est illius Echo in th. 67, quam diximus sextam optime reddere, quod nimirum quaedam illius objecti partes, quae Echum producebant, cum illo instrumenti sono maxime essent proportionatae, ut illum motum facilius quam alium in se reciperent. Ob hanc quoque causam nervi vel chordae illae instrumentorum quae duplicantur, ut in testudine et clavichordio, etc. Si ambae chordae exacte in unisono non conveniunt, sonus tamen illarum statim unitur, ut vix aliqua dissonantia percipiatur. Quia enim minima quaedam illarum vibrationum discrepantia est, possunt illae ad unisonum facile uniri. Posito enim quod diësi tantum inter sese distent ambae chordae, fiet ut dum una perficit vibrationes 128, altera saltem 125 absolvat. Quae minima discrepantia facile compensari potest, ut ad unisonum concordent.

LXXXIII.

Sunt praeterea alia plurima prorsus admiranda effectus Musicae exempla, quae apud Auctores passim occurrunt, ut apud Kircherum in *Musurgia*, ut et in magnetismo de morbo illo venefico ex Tarantulae morsu, quem nullis unquam medicamentis sanare quis potuit nisi sola Musica, et quidem non nisi certis Musicae modis ac cantilenis ad quaslibet Tarantulae species, etc., ut et de captura piscis Psyphiae, quae in freto Mamertino statis anni temporibus perficitur hoc modo, quod certis verbis prolatis pisces ad cymbam conveniant, aliaque perplurima. Ita ut non dubitet ipse Kircherus affirmare omnes in hominibus affectus et excitari et deprimi, ut et omnes hominum morbos solius Musicae ope curari posse, et quae sunt reliqua. Ex quibus, ut et ex iis quae in superioribus dicta sunt, occasio valde opportuna daretur de varia Musicae vi in nostris affectibus excitandis disserere, ut quod

diapason of the glass, and the glass was immediately consonant almost until it became a whistling, and my hand felt its tremble. When he continued this tone without interruption with a long pressure of air, the glass was broken with a noise.' Moreover: 'I have often seemed to detect a tremble in the wooden bench, on which someone was sitting next to me, and even in the table itself, on which he leaned as he spoke in a certain tone, but this did not happen when another person sitting on the same bench spoke in another tone. I have felt not once a tremble under my feet in some small room, when some certain strings of a bigger pandoura were touched, which I did not feel, when other ones were touched.' This he said. And there are countless others, which each and everyone is able to investigate with ease himself. The explanation is, however, nothing but either the equality or the conformity of the vibrations, so that they can receive such a motion in themselves.

82.

The explanation is the same for the echo in thesis 67, which we said rendered a sixth very well, since some parts of that object, which produced the echo, were without doubt very well proportioned to the sound of the instrument, so that they received this motion more easily in themselves than another. For this reason also the strings or chords of the instruments that are doubled do so, as in the lute and in the clavichord, etc. If both chords do not meet exactly in a unison, their sound is nevertheless immediately united, so that hardly any dissonance is perceived. For since there is a kind of very small discrepancy between the vibrations, they can easily be united into a unison. Provided that both chords are merely at the distance of a quarter-tone from each other, it happens that while one produces 128 vibrations, the other only detaches 125. This very small discrepancy can easily be counterbalanced, so that they concord into a unison.

83.

Moreover, there are several other quite remarkable examples of the effect of music, which can be found everywhere among the great authors, as in Kircher's *Musurgia*, but also in the magnetism from the poisonous disease caused by the bite of a tarantula, which no one has ever been able to heal with any medicines but with music alone, and actually only by certain musical modes and songs for every species of the tarantula, etc., as well as from the capture of the Psychian fish, which is carried out in the Mamertine straits at some specific times of the year in this way, that the fishes gather at the boat when certain words have been uttered, and very many others. Therefore Kircher himself does not hesitate to assert that all affects in men can be both excited and depressed, as well as all diseases of men healed, with the power of music alone, and so on. From these facts, as well as from the ones that were mentioned above, a very suitable occasion would be given to discuss the different powers of music for exciting our affects, for example

tactus tardiores motus et affectus in nobis generent tardiores, quales sunt languor, tristitia, metus, etc., et tactus velociores affectus celeriores excitent, quales sunt amor, laetitia, etc., et praeterea quomodo hi effectus ratione instrumentorum, Modorum Musicorum, consonantiarum et dissonantiarum sede ac combinatione, etc., denique etiam secundum varia cujusque temperamenta, spirituum magnitudinem, aequalitatem, motus celeritatem vel tarditatem, secundum aetates, anni tempora et tempestatum varietates, etc., singulos homines varie afficere possint, et quae sunt alia. Quarum omnium rationem quidem adferri posse non dubito, sed quia alia haec fundamenta ab instituto jam prorsus aliena requirunt, ut imprimis de affectus cujusque sede ac motu, etc., itaque haec talia omnia consulto jam omitto. Tantum.

COROLLARIA

1. Datis duabus quibuscunque quantitibus inaequalibus potest minor in infinitum augeri, ita tamen ut majorem, quae non augetur, nunquam superet, ne dum ipsi aequalis fiat.
2. Datis duabus certa specie quantitibus potest una in infinitum augeri et altera eodem modo minui, ita tamen ut illa, quae continuo augetur, alteram nunquam superet, nec illa, quae minuitur, altera fiat minor.
3. Dato triangulo rectilineo super ejus basin intra constitui possunt alia triangula, quae latera et simul sumpta habebunt majora, et utraque utrisque tam aequalia quam majora lateribus continentibus.
4. Dato triangulo rectilineo potest aliud triangulum minus constitui, quod unumquodque latus unoquoque latere majus habebit, ut et aliud triangulum, quod sit pars dati trianguli, quod tamen unumquodque latus uniuscujusque lateris multiplex habebit secundum datos quosvis numeros.
5. In omni triangulo rectilineo omnes anguli simul sumpti duobus rectis aequales non sunt.

that slower *tactus* generate slower motions and affects in us, such as weariness, sadness, fear, etc., and faster *tactus* excite faster affects, such as love, happiness, etc., and moreover how these effects can affect each and every man differently depending on the instruments, the musical modes, the position and combination of consonances and dissonances, etc., and finally also according to everyone's different temperament, magnitude and consistency of the spirits, the speed or slowness of the motion, according to the ages, the seasons and the differences in weather, etc., and whatever other things there might be. Admittedly I do not doubt that an explanation of all of this can be presented, but since these other things require fundamentals that are quite alien to our plan, as above all about the place and motion of each and every affect, etc., I now deliberately omit all such things. Enough.

Corollary

1. Given two unequal quantities of any kind, the smaller can be endlessly increased, but only so much that it never exceeds the bigger one, which does not increase, and still less becomes equivalent to it.
2. Given two quantities of a certain kind, one of them can be endlessly increased and the other diminished in like manner, but only so much that the one that is continuously increased never exceeds the other, and the one that is diminished does not become smaller than the other one.
3. Given a rectilinear triangle, on its base other triangles can be constructed within, which both have bigger sides when they are considered together, and both have sides that are both equal to each other and bigger than the sides that contain them.
4. Given a rectilinear triangle, another smaller triangle can be constructed, in which each and every side is bigger than each separate side of the former, as well as another triangle that is a part of the given triangle, in which, however, each and every side is far greater than each separate side of the former, in accordance with any given numbers.
5. In every rectilinear triangle all angles considered together are not equivalent to two right ones.

Pietate, Doctrina Morumque integritate praestantissimo Juveni,
Domino HARALDO VALLERIO,
Amico meo conjunctissimo.

Quod olim jure de se Venusinus Poëta cecinit:

Me doctarum ederae premia frontium
Dis miscent superis, me gelidum nemus
Nympharumque leves cum Satyris Chori
Secernunt populo, si neque tibiae
Euterpe cohibet nec Polyhymnia
Lesboum refugit tendere barbiton,

id merito tuo, Amicissime Domine, Tibi tribui posse, inter alia Disputatio Physico-Musica de SONO propediem publicam Lucem visura abunde evincit. Quemadmodum enim ab ineunte aetate Musicam semper cum omnibus de illa recte sentientibus in pretio habuisti, eique non sine felici successu operam navasti sedulam atque cum omnium adplausu exercuisti, ita SONI Naturam et *Concentus Harmonici* fundamenta Academico hoc, quod meditatus es, exercitio magna cum felicitate et doctrina non vulgari explicuisti. Ac utriusque rationem et causas in tenebris huc usque ferme absconditas tam solide ex veris suis principiis demonstrasti, ut, nisi Te a tuis laudibus abhorrere et aliis forte odiosum fore putarem, tuto adfirmare possem non facile ullum antea hanc materiam pari adcurazione et cura pertractasse. Id saltem sine invidia dixero, multos quidem multa in magna volumina de Musices et Soni indole congerere conatos fuisse, sed plerosque in exterioribus tantum haesisse et magis Historiam Variorum experimentorum concinasse, quam eorum, quae per magnos sumptus et curiositatem summam invenerunt, causas e Naturae adytis exsculpsisse, te vero auspiciatius intimiora SONI et MUSICES sacraria adiisse, perlustrasse indeque ea retulisse, quae a juvene vix cogitari nedum scripto comprehendere potuisset sperabamus. Tibi itaque et mihi vere gratulor. Tibi quidem, quod Musarum sacris non frustra initiatus sis, sed ea hauseris, quae Te a rudi plebe discernere atque Eruditorum choro dignum facere queant. Mihi vero, quod Te sim nactus Amicum, cujus eruditio, quam egregio hoc specimine declaras, nomen meum nunquam exstinguet, cum vitam et mores aliorum de sociis

To the young man Harald Vallerius,
most outstanding in piety, erudition and integrity of manners,
my most beloved friend.

What the Venusine poet once rightfully sang about himself:

Me the ivy, the reward of poets' brows,
links with the gods above; me the cool grove
and the lightly tripping bands of the nymphs and satyrs
withdraw from the vulgar throng, if only Euterpe
withhold not the flute, nor Polyhymnia
refuse to tune the Lesbian lyre,¹⁵⁵

that this because of your merit can be awarded to you, most beloved friend, among other things the *Disputatio Physico-Musica de Sono*, which shall see public light any day now, proves in abundance. For just as you from your first years have always valued music highly together with everyone that thinks correctly about it, and just as you not without fortunate success devoted yourself attentively to it, and practiced it with the applause of everyone, in like manner you have explained the nature of Sound and the fundamentals of harmonic concord in this academic exercise, which you have thought out, with great success and with no ordinary erudition. You have described the principle and the causes of both of them, which have almost been hidden in shades until this very time, so solidly from their true foundations, that, unless I would think that you shun your praise and that you would perhaps become offensive to other people, I could safely assert that absolutely nobody has earlier treated this subject with such thoroughness and care. I shall only say this without envy, that many have admittedly tried to collect many facts in great volumes about the inner nature of music and sound, but most people have only remained in the outer parts, and more praised the history of different experiments, than dug out the causes of that, which they have found through great expenses and great curiosity, from the sanctuary of nature. But you have entered the innermost sanctuaries of sound and music more propitiously, elucidated them, and from there related that, which we hardly hoped could be thought by a young man, and even less embraced in a writing. Therefore I truly congratulate both you and me. You certainly, since you have not been initiated into the sacred rites of the Muses in vain, but have imbibed that, which can separate you from the uncultivated crowd and make you worthy of the chorus of the erudites. But me, since I have you as a friend, whose erudition, which you demonstrate in this outstanding work, shall never let my own name fall into oblivion, since men not seldom

¹⁵⁵ Translation by C. E. Bennet, in *Horace. Odes and Epodes*. (1968), p. 5.

homines non raro soleant aestimare. Etiam id, quod jam diu anxius quaesivi, exquisita perspicuitate hic mihi explicatum reperio. Quantum vero ex prospero tuo profectu concipio gaudium, tanto afficior dolore cum recordor me ab Amico tam sincero jamjam divulgum iri. Quum autem mea fortuna id necessario requirat, dispensationi obediendum erit divinae. Vale igitur, Amice integerrime, bonisque avibus reliqua tua studia percurrere, donec Musae in honoris, quem tuae virtuti debent, culmen Te deduxerint, praemioque exanthlati laboris coronaverint. Certus enim quod *neque tibi Euterpe cohibebit, nec Polyhymnia Lesboum refugiet tendere barbiton.*

Upsaliae die 7 Septembris Anni 1674 in veteris intemerataeque amicitiae memoriam pio et illibato adfectu in patriam abiturus haec pauca reliqui
Andreas Sundius.

Ad Praestantis ingenij Juvenem,
Dominum HARALDUM VALLERIUM,
DE SONO peregre disputantem.

Musica dulce sonans Musis et amatur ab ipsis,
Et de Musarum nomine nomen habet.
Musica, VALLERI, quid sit, dum panditur abs te,
Te quoque Musarum credimus ore loqui.

Gratulabundus scripsit
Magnus Wallinus.

usually estimate the life and manners of other people from their friends. Even that, which I have already eagerly sought for so long time, I find explained to me here with meticulous clarity. As great a joy I conceive from your successful progress, with an equally great pain I am affected, when I call to mind that I am going to be forced away from a so sincere friend at any time now. But since my fortune necessarily requires so, one must obey the divine arrangement. Thus farewell, most virtuous friend, carry out your remaining studies under good auguries, until the Muses have lead you to the peak of honour, which they owe your virtue, and coronated you with reward for the endured labour. For I am sure that 'neither Euterpe shall withhold the flute, nor Polyhymnia refuse to tune the Lesbian lyre'.

I left these few words, being about to return to my fatherland, with pious and undiminished affection in Uppsala 7 September 1674 to the memory of an old and undefiled friendship

Andreas Sundius.

To the young man with a brilliant intellect,
Harald Vallerius,
when he disputes most excellently on sound.

Sweet-sounding music is also loved by the Muses themselves,
and it has its name from the name of the Muses.
What music is, Vallerius, when it is elucidated by you,
we believe that also you speak with the voice of the Muses.

With congratulations wrote
Magnus Wallinus.

2.2 Structure and Contents

Title

Dedication

Gratulatio 1

Theses

- 1–19: The fundamentals and prerequisites of sound.
- 1–4: Definition of sound, which is vibrating motion of air. Only sound outside the ears shall be considered here, in its three dimensions. Air is the subject closest to sound.
- 5–9: Definition of air. Air consists of different irregular and flexible particles. Descriptions of their inconstant movement, which also imparts motion to other particles.
- 10–16: The particles participate in different motions at the same time. The motion of air is similar to circles created when stones are thrown into water.
- 17–19: The motion of air has similarities with the movement of pendulums.
- 20–32: Creation of sound.
- 20–21: The motion of air that creates sound needs external causes, namely musical instruments. These are of two kinds, some in which a body is set in motion (e.g. strings), some that are inflated (pipes).
- 22–26: Sound in strings is explained.
- 27–30: Sound in pipes is explained. Few treatments of this matter in previous scholars. Accounts for own experiments.
- 31–32: The two kinds take place at the same time in many bodies. They are generally relevant, and explain why strings sound longer than they are struck, but pipes not longer than they are inflated.
- 33–43: Pitch (the frequency of the vibrations).
- 33: Proportions and mathematical ratios in strings.
- 34: Difference of pitch comes about from the difference in density and frequency of the vibrations.
- 35–39: Proportions and mathematical ratios in pipes. Explanations of previous experiments (in thesis 30), as well as of changes of pitch in natural trumpets.
- 40: Some bodies that are struck render several tones at the same time (bells in particular).

- 41–43: Pitch in strings again. Tension. Same pitch in every part of the string. Practical advice.
- 44–55: Volume (the quantity of the vibrations).
 44–48: Relations of volume and pitch. Consequences for volume of previously mentioned facts.
 49–55: Volume in different circumstances, based on previously mentioned facts. Explanations of well-known examples. References to contemporary authors.
- 56–67: Some further aspects of sound.
 56: Speed of sound. References to contemporary authors.
 57: Distance of sound. References to contemporary authors.
 58–62: Promotion of sound. How sound travels, penetrates bodies and affects the surroundings. References to contemporary authors.
 63–67: Explanation of echo. Not all the sound penetrates the bodies. A part of it is reflected. References to contemporary authors.
- 68–70: Duration of sound: *tactus*.
 68: Definition: the time with which we estimate the duration of sound according to a certain measure.
 69–70: The importance of *tactus* in music, which is especially evident in dances.
- 71–82: Coinciding sounds: consonances and dissonances.
 71–74: The primary consonances and their proportions (coincidence theory).
 75–77: The practical use of this theory in composition. Stress on the relativity of pleasure. Dissonance heard strongly in consonance.
 77–79: Explanation of dissonances, mainly in strings.
 80–82: Harmonizing sounds support each other in motion (sympathetic vibration), while dissonant sounds impede. References to contemporary authors.
- 83: The effects of music, rousing different affects in man. The special importance of *tactus* in this respect.

Corollary

Gratulatio 2

Gratulatio 3

2.3 Commentary

Title:

Disputatio] The word *disputatio* is here used about the printed text connected to the disputation, and this is very common, as can be seen on many title pages of dissertations of the time. It can refer both to the oral examination and to the printed text. As regards the difficulties involved in establishing a general definition of the concept of *disputatio*, see Marti 1994.

De SONO] Stating that questions of acoustics and sound, and their implications for music theory, were in vogue at this time would hardly be an exaggeration. The literature on the subject referred to by Vallerius in the dissertation is certainly enough to mirror this, as does also, for instance, the fact that a considerable portion of the activities performed at the meetings of the Royal Society, which was founded in 1660, had to do with acoustics (see further e.g. Hunt 1978, pp. 82 ff.; Dostrovsky & Cannon 1987; Gouk 1999, pp. 157 ff.; and Wardhaugh 2008, pp. 71 ff. for sketches of the general development of the science of acoustics during the 17th century. As regards the mathematical and mechanical study of music in the early Royal Society, see Wardhaugh 2008, pp. 98 ff.).

ANDREAE NORCOPENSIS] Andreas Nilsson Norcopensis (1633–1694) matriculated at Uppsala University in 1650. As his name reveals, he had his origins in Norrköping in Östergötland, and thus he was member of the same student nation in Uppsala as Vallerius. Having been the privat teacher of Counts Nils Bielke (the future Field Marshal) and Gustaf Krus, with whom he also carried out peregrinations abroad for several years, he was first appointed professor of philosophy in 1667, but later professor of Latin rhetoric in 1672 (as can be seen on the title page). As a professor he was the praeses of no fewer than 88 disputations. In 1686 he was appointed private tutor of crown prince Charles (later Charles XII), and in 1687 ennobled under the name Noordenhielm. He was a proficient Latinist, and translated the first volumes of Olof Rudbeck's *Atlantica* from Swedish to Latin (*SBL*, s.v. *Noordenhielm*). For Vallerius's dissertation *pro gradu* from 1678, defended under the presidency of Matthias Steuchius, Andreas Norcopensis wrote another congratulatory address that was printed at the end of the publication. But that time he wrote it as Vallerius's friend.

Auditorio Gustaviano Majori] The *Auditorium Gustavianum majus* was the largest lecture hall in the university building *Gustavianum*, built in 1622–1625 thanks to a donation by Gustavus II Adolphus and located next to the cathedral.

ad diem [4] Novembris] The exact date was not printed, but has been supplied here from the handwritten insertions made in the copies examined. In neo-Latin texts, the name of the month is usually treated as a noun (cf. e.g. Tengström 1983, p. 71).

horis ante meridiem consuētis] Public examinations usually took place on Wednesdays and Saturdays, and started at 7 a.m. or once in a while at 8 a.m. (Annerstedt II:2, p. 130).

Sacrae Regiae Maiestatis Alumnus] In the 1670s it was decided that royal scholarships could be granted to students thanks to their participation in university music (Kyhllberg 1974, p. 112).

Nicolaus Wankijff] Nils Wankijff was son of Nils Olsson, vicar in the parish of Wankifwa in Skåne in Sweden. He was granted a letter of attorney as a royal printer on 26 May 1669, and held that position until his death twenty years later. Under the name of his widow the printing house continued until 1705 (Klemming & Nordin 1983, pp. 174 f.).

Dedication:

Senatori et Cancellario] *Senator* is at this time the title of a *Riksråd* (Royal Councillor), *cancellarius* means ‘chancellor’ (Helander 2004, pp. 205 and 210; *DMLBS*, s.v. *cancellarius*). The dedicatee Magnus Garbriel De la Gardie held the position as *Rikskansler* (head of the *Collegium Cancellariae*) between 1660 and 1680. He was appointed a Royal Councillor in 1647.

Judici Provinciali] As regards the translation, cf. Helander 2004, p. 208, where the position is described as ‘chief judge in a district of jurisdiction’.

Academiae Upsaliensis Cancellario] In addition, the dedicatee had in fact also been the Chancellor of Uppsala University since 1654.

MAGNO GABRIELI DE LA GARDIE] Magnus Gabriel De la Gardie (1622–1686) was one of the most important characters in 17th-century Sweden. Some of his positions are mentioned above, and some of his titles follow after his name in the dedication. As a member of the high nobility and one of the wealthiest men in Sweden, he had a great impact on contemporary politics. Being the favourite of Queen Christina for some years around 1650, he married the sister of the future king Charles X Gustavus. In 1655 he was appointed Governor General of Livonia, and as mentioned Chancellor of the Realm in 1660. In 1680 he became Chancellor of the Judiciary. His huge cultural importance is partly due to his position as the chancellor of Uppsala University, and partly to his great efforts as a patron and commissioner of magnificent buildings.

excipere] As regards the word in this sense, cf. *OLD*, s.v. *excipio*, 7.

favorem Tuum erga Musices Studiosos] The importance of Magnus Gabriel De la Gardie as a patron of music is also attested in Emil Trobäck’s article from 1930, in which De la Gardie’s *Hofkapelle* is described over a

few pages. This consisted of organists, lutenists, singers, an ensemble of violins, some trumpeters and drummers, and seems to have been an attractive means for many young musicians to get an employment and further education. This can be seen in the many applications still preserved (Trobäck 1930, pp. 74 f.).

vile hoc exercitium inscribere nunquam auderem] Vallerius in the dedication performs the almost obligatory *recusatio*, i.e. he expresses his own great modesty as the author (cf. e.g. Helander 2004, pp. 533 ff. and van Dam 2008, pp. 26 f.). If the dedicatee approves of it, this depends on his benevolence and grace alone, not on the quality of the work.

We here see explicitly that Vallerius's *De sono* was only *pro exercitio*. Such a disputation was necessary for passing the preparatory examination of the *filosofie kandidatexamen* (BA), among other things (Lindroth 1975, III, p. 32, and Annerstedt 3:2, pp. 169 and 224). Vallerius's dissertation *pro gradu* was the *De vacuo*, defended under the presidency of Matthias Steuchius in 1678. There this information is also indicated on the title page. Hansson (1967, p. 47) thus wrongly claims that *De sono* was a dissertation *pro gradu*.

Devotissimus cliens] Vallerius's own words define the relationship between author and dedicatee, not least with regard to their positions in social hierarchy. By calling himself *devotissimus cliens*, just as with the earlier *Domino meo benignissimo*, Vallerius officially expresses his fidelity and obligingness towards De la Gardie, who had become Vallerius's patron shortly after his arrival at Uppsala university. By the allusion to the ancient Roman system of patronship, which is implicit in phrases of this kind, he also requests further protection, and even direct support (cf. Johannesson 1988, p. 27). A connection between dedications and actual financial assistance for the printing can often also be discerned in the book market of the time as well (Hansson 1988). Another aspect of the dedicatory practices displayed in early modern books, stressed by Karl Enenkel (2008), is the fact that the dedication serves as a mutual act of authorization between dedicatee and author. While the author's praise extols the merits of the dedicatee, the dedicatee's presence in the book, and his qualities, which are here described by the author himself, lend authority to the author and the publication.

Gratulatio 1:

verba Philosophi] The quotations in Greek that follow are both taken from Aristotle's *De anima* II. 420a, where the conditions of resonance and hearing are treated, and they recall definitions that had been immensely influential both in antiquity and in the Middle Ages (e.g. Hunt 1978, p. 23, and Burnett 1991, p. 43 ff.). Vallerius later alludes to these traditional definitions in the very first thesis of the dissertation (*sicut hactenus Philosophi communiter consueverunt*), only to say that he is not

going to use them in his study. This was in accordance with scientific development, in which Aristotle's view on sound had been questioned more and more, a process that continued during the 17th century (see Wittmann 1987, pp. 269 ff.). The *Philosophus* referred to several times in this gratulatory address is thus Aristotle.

However, Norcopensis's quotations from Aristotle are somewhat surprising at this point. They could seem to be criticisms of aspects of Vallerius's dissertation. Why would he otherwise repeat definitions that the respondent has obviously avoided using? Norcopensis was professor of rhetorics, and not specialized in physical questions. One suggestion has to do with the situation in the academy at this time. There had been great controversies between Cartesian and Aristotelian philosophers some years earlier, and would be again some years later (see e.g. Lindroth 1975, pp. 447 ff.; Annerstedt II:1, pp. 91 ff. and 255 ff.; and Lindborg 1965, pp. 67 ff.). Norcopensis was as a professor naturally involved in these, and he would later appear in a Cartesian context expressing very harsh words on the Greek philosopher, e.g. calling him *fallax Haeresiarcha*, 'the deceitful leader of the heresies' (on which see Helander 2004, p. 449 f.). By quoting Aristotle in Vallerius's dissertation he perhaps wanted to meet the Aristotelians half way, so to speak, in order to reduce the risk of hard feelings from their side. What at first looks like criticism, could thus be considered as a kind of protection from Norcopensis, with the intention of saving the respondent, and himself, from the attacks of the Aristotelians at the university.

qui sibi nomen de celebri Peripato sumpserunt] i.e. those who call themselves Aristotelians, and followers of Aristotle.

The Greek περίπατος, from περιπατέω ('walk about'), was Aristotle's name for his lectures which took place while walking (Liddell & Scott, s.v. περίπατος, II, 2). It is attested in Latin as *peripatus* in Cassiodorus, in the sense of 'place for walking' (Blaise [1], *TLL*). Noltenius (col. 326) translates the word as *disputatio philosophica*.

qualitas audibilis] In philosophical terminology at the time, following the Aristotelian tradition, *qualitas audibilis* quite simply refers to sound. Cf. Micraelius's (1661, cols. 1188 f.) explanation of the term, in which a quality is seen as a property of a natural body, according to which this body is disposed for doing or enduring something: *Qualitas physicis est affectio seu proprietas corporis naturalis, qua illud disponitur ad aliquid agendum seu patiendum*. The physicists thereafter divide qualities into certain groups: (I) active or passive, (II) material or spiritual, (III) hidden or perceivable, (IV) according to the senses: *in qualitate visibilem qualis est lux et color; in audibilem, qualis est sonus; in odorabilem ceu est odor*, etc., (V) primary (heat, cold, dryness, humidity, etc.) or secondary, which are the consequences of the primary ones.

The essence of Andreas Norcopensis's words in the first sentence is thus that the definitions and categories of Aristotelians of later centuries have made the question of sound much more obscure and difficult than it was as defined by Aristotle himself. This idea also returns more explicitly somewhat later in the congratulatory address.

non exiguum illi lucem ... in dies accedere] Cf. what was said in the commentary on the title above on the progress of acoustics in the 17th century.

In eo genere habemus ... satis inigne] The commendation of Vallerius's work in this passage, consisting of three different parts, seems to reflect something of a pedagogical programme. (I) *In eo genere* refers to the previous *lucem ab ingenio observationibusque*; Vallerius has contributed to shedding further light on a difficult question through intellectual activity and observations. The growth of knowledge that Vallerius's dissertation represents is thus something praiseworthy. (II) The phrase *rerum varietate jucundum* is more connected to style. Through *varietas* Vallerius has managed to achieve the rhetoric good of being pleasant (*delectare*). (III) In *diligentia tua satis insigne* the importance of scholarly diligence and industry is inherent. In that perspective the congratulatory address by the professor Andreas Norcopensis must also be understood as part of the pedagogical situation, reflecting values previously stressed in the education itself. To the more general paratextual functions carried out by Norcopensis's congratulatory address, where praise becomes recommendation and information becomes presentation (cf. Genette 1997, p. 265), we could in this case thus add the pedagogical one, the intended audience including both Vallerius himself and other students.

in Musarum cultu] The Muses at this time very often represent academic learning and scholarly work (cf. Helander 2004, pp. 553 ff.), and this is obviously the case here. Accordingly Vallerius's good spirit and manners during his time at the academy, as well as his diligent studies are stressed.

tui similibus nemini culmen, quo niteris, inaccessum fuit] The peak refers to the Parnassus, the mountain sacred to Apollo and the abode of the Muses. The hardships involved in climbing it, and the labour necessary, is a topos in literature of the time (cf. e.g. Henkel & Schöne, cols. 61 ff.). Once again Vallerius's diligence is thus commended here. Moreover, still today at doctoral promotions at Uppsala University, the *promovendi* must climb a symbolic Parnassus in order to receive their doctoral diploma. A link between winning the degree and climbing the Parnassus can therefore also be established (as regards promotion ceremonies in Uppsala at Vallerius's time, see Nevés 1986, pp. 18 ff., and 137 ff.). The words of the praeses function as an exhortation to continue to struggle in the same way. From this dissertation *pro exercitio* it then took Vallerius another four years until he defended his dissertation *pro gradu* and won the master's degree.

Theses:

1. **Thesis]** The Greek word *thesis* occurs in Latin literature as early as Cicero, who translates it as *propositum*. In Quintilian it becomes a rhetorical *terminus technicus*, rather in the sense of *quaestio* (Krebs & Schmalz, cf. *OED*). The sense especially relevant here, and in the entire dissertation, Noltenius explains as *Ein gewisser Satz, Eine Thesis in einer gelehrten Untersuchung*, and he gives *propositio* as a Latin equivalent (Noltenius, col. 1196, cf. Micraelius 1661, col. 1340, and *OED*, s.v. *thesis*, 4).

Per sonum intelligo ...] Vallerius's definition of sound, just as many other views on the subject that are treated in the dissertation, basically follows that of Mersenne. The French philosopher at the outset of his *Harmonie universelle* concludes: ... *le Son se peut definir 'un mouuement de l'air exterior ou interieur capable d'estre ouy'* (Mersenne 1636–1637, p. 2; cf. Dear 1988, p. 140). But this conception of sound was certainly shared by several other scholars as well. Descartes, for instance, wrote in a letter to Mersenne: *Il fault supposer le son n'estre chose qu'un certain tremblement d'air qui vient chatouiller nos oreilles* (quoted from Pirro 1907, p. 3). In his lectures on Petrus Hoffwenius's procartesian *Synopsis physica*, Vallerius himself in 1698 similarly stated that sound outside of our perception is nothing else than a trembling motion of air: *ita ut sonus extra perceptionem nostram nihil aliud sit quam tremulus motus aëris* (Uppsala University Library, A 204, p. 112). Another treatment of sound, which mostly seems to be a summary of the ideas in *De sono*, can later also be found in, for example, the *Disputatio physica de qualitatibus corporum naturalium* (1700, pp. 27 ff.), a dissertation defended under Vallerius's presidency.

In contrast, we meet in Kircher's *Musurgia universalis* with a definition that is closer to the traditional Aristotelian one. Although stressing that sound is naturally connected to the sense of hearing, Kircher still contends that sound has its origins in the collision of sounding bodies (1650, vol. 1, p. 3; cf. vol. 2, pp. 239 f.):

Nos sonum definimus esse qualitatem passibilem successivam ex aeris, vel aquae interceptione, elisioneque sonantium corporum collisionem insequente producta, sensus auditus movere aptam.

Vallerius's view of sound as a sensation from trembling motion of air is thus representative of the more modern ideas gaining ground in the 17th century, which contradicted both Aristotle and the Pythagorean tradition: 'By now scientists and philosophers agreed that sound had no physical reality outside the consciousness of hearing animals' (Palisca 2006, p. 27).

sensationem] The word, which is first attested in Irenaeus in the sense of 'understanding' (*TLL*, Blaise [1], Du Cange, s.v. *sensatio*, I), should here

be understood closer to the more modern sense of ‘perception by the senses’ (cf. Hoven).

accidens ... reale] What we see is a *terminus technicus* inherited from Scholastic theological terminology. There *accidens* refers to the occasional or non-essential properties of a thing. The specific *accidens reale* in philosophical handbooks of the time can be described as the *accidens* that is inherent in the form of a thing: ‘*Accidens physicum*’ seu ‘*reale*’ est, quod est forma inhaerens (Micraelius 1661, col. 22). Francisco Suárez (1548–1617), whose *Disputationes metaphysicae* (1597) was used as a textbook at universities all over Europe in the 17th century, distinguished between *accidens* as a *modus entis* and *accidens reale*. The latter he described as: *Accidens non est ens per denominationem extrinsecam a substantia, sed per intrinsecam entitatem suam, secundum quam habet suum proprium esse* (‘the *accidens* is not a being by a denomination extrinsic of the substance, but by its intrinsic entity, according to which it has its proper being’). See further *Enciclopedia filosofica* 1957, cols. 36 f. (from where the quotation from Suárez above is taken).

The word *realis* can be first attested in the same sense as early as the 3rd-century author Marius Victorinus (Souter), and as a philosophical *terminus technicus* in medieval Latin (Blaise [2], Latham). It is rejected both by Noltenius (col. 700) and Krebs & Schmalz.

sicut hactenus Philosophi communiter consueverunt] What Vallerius refers to is summarized in the words of Penelope Gouk: ‘The Aristotelian idea that sound was produced by the striking of two bodies one against the other, carried through a medium to the ear, was a commonplace of sixteenth- and seventeenth-century thought’ (Gouk 1991, p. 98, cf. Burnett 1991, pp. 52 ff.). Illustrative is again also Micraelius’s (1661, col. 1272) description: *SONUS, qualitas audibilis, excitata ex subita corporum inter se facta collisione* (‘Sound, the *qualitas audibilis*, is stirred when there has been a sudden collision of bodies in relation to each other’).

a praestantissimis hujus aevi Philosophis] Among the scholars contemporary with Vallerius that consider sound as pure motion (*tantum ut motum*) we find such prominent names as Galileo Galilei, Marin Mersenne and René Descartes (cf. Wardhaugh 2008, p. 76).

hunc motum extra aures nostras solum considerare] In the discourse of the time, questions on the nature of sound were naturally closely related to theories on the functions of the ear and the faculties of hearing (on which see e.g. Finger 1994, pp. 111 ff., and Wardhaugh 2008, pp. 59 ff.). Vallerius thus deliberately decided not to consider that part of the subject, as well as to omit discussing the different definitions of sound. However, in the *Disputatio physico-mathematica de superficie corporum naturalium* (1701), defended under Vallerius’s presidency, hearing is defined as ‘the sense by which the soul perceives sounds from an adequate motion of the

small fibres of the auditory nerve, which has been carried on into the ears, and which has been delivered into the brain to the common sensory organ (p. 66):

... sensum, quo ex justo fibrillarum nervi auditorii motu auribus impresso, et in cerebrum, ad sensorium commune delato, anima sonos percipit.

secundum trinam dimensionem] These three dimensions of sound, which Vallerius will treat much further later in the dissertation, are pitch (*profunditas*), volume (*latitudo*) and duration (*longitudo*). As can be seen, sound shares the Latin names with the three physical dimensions, in a terminology that certainly was not an invention of Vallerius. We meet in the *Synopsis musicae novae* of Lippius, for instance (1612, fol. B5r): *Si igitur Sonus magnus est comprimisque numero discretus: erit idem etiam sic juxta trinam dimensionem Longus, Latus et Crassus*. The word *crassus* thus corresponds to Vallerius's *profundus*, while *latus* in Lippius has to do with dynamics in a wider sense, including features of expression. Also Gezelius (1672, p. 574) uses *longus*, *latus* and *crassus* for these three dimensions, with definitions taken from Lippius.

2. **quomodo possit illa ... affici]** As Vallerius has already said in the first thesis, he will not treat hearing, neither will he deal with how the mind is able to perceive, and to be affected by sensations at all. Among these questions, that of how the brain reacted to sound was especially difficult. For in hearing and vision the sense organs were not regarded to be moved in the same way by sensation, as in for example touching and tasting. For the medieval background of these ideas, which remained influential in the 17th century, see Burnett 1991 (especially pp. 61 f.). Mechanical explanations of the perception of sounds were attempted for example by René Descartes and the Dutch scholar Isaac Beeckman (1588–1637), but not entirely successfully, not even according to the opinions of their own time (on which see Cohen 1984, pp. 139 ff. and 172 ff.). Perception is later dealt with in detail in several dissertations defended under Vallerius's presidency, e.g. in the *Dissertatio physica de certitudine sensuum* (1682); in the *Disputatio physica de albedine* (1699); in the *Disputatio physica de qualitatibus corporum naturalium* (1700, pp. 4 ff.); and in the *Dissertatio philosophica de fallaciis sensuum* (1705, pp. 16 ff.). For a history of the sensory systems in a broad perspective, see Finger 1994, pp. 65 ff.

per species sentire] The word *species* in this sense was a philosophical *terminus technicus* in Classical Latin, and it was to be used in order to describe the perception of the senses (cf. Cohen 1984, p. 24). Micraelius explains the intended nuance here as when unreal images of objects are presented as a real object to the senses or the mind (Micraelius 1661, cols. 1275 f.):

SPECIES sumitur (1) physice ... pro specie sensibili seu intelligibili, qua non reales, sed spirituales et intentionales imagines objectorum a materiae concrezione liberae objectum reale sensui vel intellectui repraesentatur [sic].

3. **organorum constitutionem, per quae mens sonum sentit]** Vallerius had already in the first thesis said that the ear would not be treated (see the comments there), but by repeating the information he manages to specify the disciplines that could also deservedly have been dealt with in connection with the subject. In Kircher's *Musurgia* we find an extensive treatment of hearing in vol. 1, pp. 13 ff. As regards the scientific progress within anatomy with regard to brain function at this time, see Finger 1994, pp. 20 ff.

menti quoque repraesentent] The concluding sentence of this thesis adds precision to the concluding sentence of the former; the mind cannot only be affected by motions from the physical world, but all sounding motions are actually presented to the mind in a like manner. For a discussion of early modern theories on how sound was considered to affect the mind, see Wardhaugh 2008, pp. 66 ff.

4. **aërem esse proprium soni subjectum]** This was of course the view of several of the philosophers of the time. Mersenne, for instance, early in his *Harmonicorum libri XII* (1648, p. 2) writes that air is the most noble subject of sound, since it is the most mobile of all bodies that we make use of (*aër est nobilissimum ... subiectum soni, cum sit omnium corporum, quibus utimur, mobilissimum*).

The word *subjectum* in philosophical terminology of the time has several nuances. In our case the term means a 'substance in which' (the Greek ὑποκείμενον), and refers to something characteristic and to a natural capacity (cf. L&S, and Blaise [1], s.v. *subiectum*, 1). Micraelius describes it in simple terms as being linked to accidents either through generation, by attribution, or by occupation: *Subjectum in terminis simplicibus est vel generationis ... vel est attributionis; vel occupationis*. The *subjectum attributionis* can be described as a receiver of the accident that can be so by inherence. It is then called a substance in which, or a material in which, and it refers either to some property and natural potency, with which it necessarily coheres, or some common adjunct, which does not necessarily inhere to it (Micraelius 1661, cols. 1301 f.):

... receptivum accidentis, est vel inhaesionis, et dicitur subjectum IN QUO, seu materia in qua: respicitque sive proprium aliquod et potentiam naturalem, qua cum necessario cohaeret ... sive adjunctum aliquod commune, quod non necessario inhaeret ...

For a more extensive treatment of the term in the philosophy of the time, see Goclenius 1613, pp. 1086 ff.

sonus pro varia constitutione aëris semper mutetur] The different appearances of sound in different conditions of air will be further treated in theses 52 ff. below.

medio] The sense of the word *medium* has here developed from the medieval Latin usage of it for ‘means’ or ‘instrument’ (cf. Benner & Tengström 1977, p. 60, but also Noltenius, col. 613, and Krebs & Schmalz, who both reject it). In philosophical terminology of the time it presupposes a movement in some direction: *Medium in physicis, qua motum alio respectu est a quo; alio ad quod; alio circa quod* (Micraelius 1661, cols. 745 f.). But as can be seen, Vallerius seems to have considered it almost synonymous with the previous *materia*. The intended sense can thus be grasped from the common usage of the word in discussions on perception: ‘An intervening substance ... through which impressions are conveyed to the senses’ (*OED*, s.v. *medium*, 5. a).

5. **Intelligo autem per aërem ...]** This definition of air returns in the *Disputatio physica de atmosphaera terrae* (1699), defended under Vallerius’s presidency, in similar but somewhat different words ‘air is a fluid and transparent body, that surrounds our Earth on all sides, consisting of irregular, branch-like, slender and flexile particles, which are separated from each other in a constant motion’ (p. 10): *Aër est corpus fluidum et pellucidum, terram nostram undiquae [sic] cingens, constans ex particulis irregularibus, ramosis, tenuibus et flexilibus, a se invicem perpetuo motu disjunctis*.

Atmosphaera] A neo-Latin neologism, from the Greek ἀτμός (‘vapour’) and σφαῖρα (‘sphere’), referring to the envelope of vapours that extends from the Earth out into space (cf. *OED*, s.v. *atmosphere*, 1 [in English first attested in 1638, on the ‘atmosphere’ of the moon]), as well as Micraelius’s description (1661, col. 189):

Atmosphaera, illud spacium aeris, quousque ascendunt exhalationes e terra: regio nempe vaporum, qua terra quasi circumvestitur, et ex qua causa crepusculorum quaeritur.

particulis] The word is invested with many connotations for modern readers. But Micraelius still explains it quite simply as: *partis pars* (Micraelius 1661, col. 975; cf. *OED*, s.v. *particle*, I, 1, a).

Quod ... existimo] According to the standards of Classical Latin, we would here have expected an *accusativus cum infinitivo* instead of a *quod*-clause. Cf. the notes on syntax in section 1.5.1 above.

meteora] From the Greek μετέωρος (‘high in the air’), attested in late Latin in a more general sense than here (cf. Blaise [1], *TLL*, s.v. *meteorus*). BFS (s.v. *meteoros*) explains it as: *Meteora, quorum materia sunt fumi vel ex-*

halationes ex terra et aquis, and alles was sich oben in der Lufft zuträgt (cf. *DMLBS*, s.v. *meteorus*, 1; and *OED*, s.v. *meteor*, A, 2).

ut etiam animalia] The word *animal* here includes both animals and human beings, for whose life air is a prerequisite. Cf. Micraelius (1661, col. 124): *Animal est corpus animatum sentiens. Platonici tamen, ut Aristoteles, ipsum Deum et Intelligentias coelestes vocaverunt quoque animalia.*

Quia ... asseruerit] According to Classical standards, we would have expected an indicative in this *quia*-clause, and generally Vallerius has it. Cf. the notes on syntax in section 1.5.1 above.

figura] Basically the sense is here ‘outward appearance’ or ‘shape’, but the word is also a technical term for geometrical figures in Classical Latin (*OLD*, s.v. *figura*, 6, b).

8. **sclopetis]** The word can be found used for ‘gun’ or ‘firearm’ in texts from the late Middle Ages, and is obviously related to a hapax in Persius, *scloppus*, which designated ‘the sound made in striking something full of air’ (*OLD*). A more exact sense in neo-Latin can only be established from the context in each specific case (see further Helander 2004, pp. 193 ff., cf. *LLNMA*, s.v. *sclopetus*).

9. **determinationis]** In scientific language of the time, *determinatio* is to be understood in the sense of ‘direction’ (*OED*, s.v. *determination*, 7, a). Obviously this has developed from philosophical usage, where in one definition each and every cause in a certain object has a determination, just as virtue has in a certain subject. ‘Thus condition determines the natural capacities, virtue the will, God all that is’ (Micraelius 1661, col. 365):

Determinatio etiam est causae cuiusque in objecto certo, ut et virtutis in certo subjecto. Sic habitus determinat potentias naturales, virtus voluntatem, Deus omnia entia.

intrinsicam] In Classical Latin *intrinsicus* is only used as an adverb, but appears as an adjective in late Latin (Blaise [1], s.v. *intrinsicus*, II; and *TLL*, s.v. 2 *intrinsicus*). Noltenius (col. 590) under the form *intrinsece* condemns the usage as an adjective, just as *intrinsicus*, which he considers to be very common in the scientific language of his time: *perperam dicitur ... si Adjective usurpatur: qua tamen forma barbara passim nunc apud Philosophos utrumque legas.*

10. **de pluribus ... motibus participant]** This use of the intransitive *participo* with *de* is post-Classical, and first attested in the Church fathers (*TLL*, s.v. *participo*, 507, 31 ff.). It should most likely be understood in connection to the extended usage of *de* in partitive constructions in late Latin (on which see e.g. Löfstedt 1928, pp. 145 ff.).

ut omnes hi motus non multum sese invicem impediunt ...] It is true that Vallerius almost says the same as Mersenne here, but there is indeed a noteworthy difference in how they express the matter. Vallerius has contended that particles of air can participate in several motions at the same time, without greatly impeding each other. Mersenne's aim seems to be the opposite, viz to show that motions really can impede each other, by simply stating (Mersenne 1648, p. 6): *soni sibi invicem occurrentes se impediunt*. Somewhat later he continues with the claim that, almost like two opposite winds, a contrary motion can break another motion, or at least diminish it (*duorum fere ventorum oppositorum instar, motus enim contrarius alterum motum frangit, aut saltem minuit*). As we can see, at the end of the thesis, Vallerius also mentions how the wind checks other kinds of motions to some degree. As regards this question, see also the commentary on thesis 12 below.

11. lapidem in aquam immissum ... circulos efformare] Perhaps the Stoic philosopher Chrysippus (c. 280–207 B.C.) was the first to formulate the analogy between ripples created on the surface of the water when a stone had been thrown into it and waves of sound spreading in the air (Hunt 1978, pp. 23 f.). The idea became widespread already in Antiquity. We find it for example in passages in Vitruvius's *De architectura* (5.3.6 f.) and Boethius's *De institutione musica* (1.13), and it also occurs frequently among Vallerius's contemporaries. Interestingly, however, it is especially associated with the Cartesian school in the *Dissertatio gradualis de antiqua et medii aevi musica* (1706, p. 1), which was later defended by Harald's son Georg Vallerius under Johan A. Bellman.

12. Si autem lapis flumini ... immittatur] Descartes adduces the simile of sound and the movement of circles created by stones on the surface of a river in a letter from 1646. Notably, the alleged author of the comparison is here Aristotle (quoted from Pirro 1907, p. 4):

le son ... se peut assimiler au mouvement des cercles produits dans l'eau d'une rivière lorsqu'on y jette une pierre, comparaison faite par Aristotle, ou au mouvement causé par les vents sur l'eau courante.

unus super alium] The use of *unus* in a phrase of this kind is labelled as post-ancient in Krebs & Schmalz (s.v. *unus*, 3), the proper Classical variant being *alius super alium* (cf. Noltenius, col. 1811).

se invicem tamen non impediunt] In fact Mersenne seemingly wants to prove quite the opposite matter with the simile of stones thrown into water, claiming that the circles actually do impede each other: *motus aëris facti a diversis, sibi praesertim oppositis, se more circulorum ab oppositis in flumine lapidibus productorum impediunt* (Mersenne 1648, p. 6).

13. **secundum Gassendum]** The vague reference goes to Pierre Gassendi (1592–1655), the French philosopher and scientist, but I have not been able to find the exact location of this information in his writings. It is true that Gassendi in *Animadversiones in decimum librum Diogenis Laertii* ... (1649, p. 279), for instance, compares sound with a stone thrown into water, but he does not mention the absence of waves under the surface at that instance. Moreover, Vallerius's acquaintance with Gassendi's works is visible in the list of books borrowed from Uppsala University Library from the time. After 1694, when the list starts, Vallerius borrowed books written by Gassendi at six different times (Uppsala University Library, *Bibl. arkiv*, G:1).

ad minimum] Krebs & Schmalz label this phrase as late Latin and very rare, while Noltenius (col. 1262) thought it had been influenced by the Italian and Spanish languages.

14. **circumferentiam]** The word is first attested in late Latin (*TLL*). It was rejected by Noltenius (col. 462), although he claimed he had found the word in Apuleius. Instead he suggested the usage of *extremitas*, *quae in orbem circumque fertur* or even *peripheria*.

15. **sensibiliter]** The adverb is first attested in the late Latin author Arnobius (Blaise [1], Souter). But *sensibilis* is also disliked by both Krebs & Schmalz and Noltenius (col. 1168), the former stating that the word is very rare in post-Classical Latin and *nur als philosophisches Kunstwort ... erträglich und anwendbar*.

Prester, Typhon, Turbo, Exhydrias, Ecnephias] The enumeration lists some aerial phenomena, where *Prester*, *Typhon*, *Turbo* and *Ecnephias* are different kinds of whirlwinds (JPG, Matthiae). In the *Exercitium academicum de ventis* (1709, pp. 49 ff.), defended under Vallerius's presidency, the *typho* and the *ecnephias* are later treated in greater detail, as examples of more violent aerial phenomena. On the latter of them it is there written: *Ecnephias Graecis, Tavados Lusitanis, procella autem Latinis dictus fuit* ('it was called *ecnephias* in Greek, *tavados* in Lusitanian, but *procella* in Latin'). The *Exhydrias*, which is mentioned once in Apuleius, is a stormy wind with rain. It should be *Exhydriae* considering the origin in Greek ἐξυδρίαὶ ἄνεμοι (L&S), but *Exhydrias* can in fact be attested as the appropriate form in lexica of the time (e.g. Matthiae).

17. **cursus et recursus]** The terminology accords with Mersenne's treatment in the *Harmonicorum libri XII*, when he explains the motion of a string, and states that the first part of the motion, from C to D or from D to C, is called *cursus* or *excursus*, while the second part, from C to D or from D to C, is called *recursus* (1648, p. 15):

Statuamus autem primam partem motus, quae fit a C, ad quod deducta est chorda AB, usque ad D, vel a D usque ad C, vocari cursum, vel excursum: secundam vero motus partem, qua redit chorda a C ad D, vel a D ad C, vocari recursum: possent etiam partes motus istius *itus*, et *reditus*, vel *fluxus*, et *re-fluxus* appellari.

Kircher (1650, vol. 1, p. 416) likewise states that the *curso-recursus* or *diadromi* are to be defined as ‘vibrations of strings that are tensed vertically, or natural vibrations: namely their motions here and there’ (*vibrationes chordarum pendularum sive naturales: earum motus hinc inde*). As regards this weakened sense of *recursus* in scientific discourse at this time, cf. also *OED*, s.v. *recourse*, n¹, II.

funependulis] The word is a neo-Latin coinage, made up by the word *funis* (‘rope’) and *pendulum*, the latter also being a neo-Latin neologism of sense (cf. Du Cange, *Matthiae*), to which *funependulum* is an equivalent (cf. Gehler 1833, p. 304).

paulo exquisitius considerasse plurimum juvabit] Vallerius’s treatment of the pendulum in the following obviously builds on geometrical proof, not on observations, and his theory is therefore false from a physical perspective. A pendulum that is half the length of another does not move twice as fast as the longer one.

18. **Mersennum in sua *Ballistica*]** Marin Mersenne in greater detail treats many similar aspects of the pendulum briefly mentioned by Vallerius in this thesis in his *Ballistica et acontismologia* (1644) on pages 38 ff. As regards Mersenne’s approach to the pendulum problem, see also Hunt 1978, pp. 87 ff. and Dear 1988, pp. 163 ff.

19. **notandum venit]** The construction of *venire* with a gerundive in this sense is typical of neo-Latin scientific prose, especially with verbs that mean ‘observe’, ‘consider’ and ‘remember’ (Helander, forthcoming), even though the feature can be found in ancient literature (K.-St., I, p. 731). Both BFS and Noltenius (col. 1795), however, considered it as being characteristic of poetry, and the latter stated that *notandum est* was proper for prose writings.

Mechanicae] The feminine noun *mechanica* is first attested in late Latin (*TLL*, s.v. *mechanicus*, 516, 16 ff.). Noltenius (col. 611), however, suggests *mechanica ars* or *mechanice*, while Matthiae accounts for both *mechanica* and *mechanice* as correct forms.

ut distantia ad distantiam, ita reciproce potentia ad potentiam] This mechanical law has its origins in the allegedly Aristotelian *Problems of Mechanics*, which deals with the lever, and how weights can be moved more easily when there is a greater distance between the moving force and the fulcrum (on which see Dugas 1988, pp. 19 ff.). In Claude François Milliet

Dechales's *Cursus Mathematicus* (1674), a book of which Vallerius later himself made extensive use (Rodhe 2002, p. 17), a section is devoted to how Aristotle had considered mechanics. In a Latin quotation of this alleged Aristotle, we meet the same thought explicitly stated (Dechales 1674, vol. 1, p. 398):

Quam igitur ob causam ab eadem potentia celerius fertur id quod plus a centro distat, ex iis quae dicta sunt est manifestum ... semper autem quanto ab hypomoclio distabit magis, tanto facilius movebit.

sinus] The concept of sine has its origins in India, where it was called *ardha-jya*, or simply *jya* or *jiva* ([half of the] chord). It came to Europe in the Middle Ages by mediation of Arab scholars, who had retained the word *jiva*, of which *sinus* is in fact an incorrect translation (the word was similar to an Arabic word meaning 'cavity', 'bay', 'gulf'). This was thus mistakenly thought to be Arab. The word *sinus* is first attested in Latin in the works of Gerard of Cremona in the 12th century (*Encyclopedia Britannica*, s.v. *trigonometry*, cf. Latham). At the time of Vallerius, the sine is still considered geometrically as a line "drawn from one end of a circular arc parallel to the tangent at the other end, and terminated by the radius" (*OED*, s.v. *sine*, n², 2, a; see also Tropfke, vol. 5, p. 19).

in corpore A et E aequalibus] In what looks like a simple mistake of Vallerius, we would expect a *corporibus* rather than the ablative singular.

habuit] We would here rather have expected either the present form *habet*, or even the future perfect form *habuerit* (cf. K.-St., vol. II, pp. 374 f.).

posito] The absolute *posito*, followed by a *quod*-clause or an *accusativus cum infinitivo*, was rejected as bad Latin in several authorities (BFS, s.v. *pono*, Nolténus, col. 1658, Krebs & Schmalz, s.v. *pono*, 6), although, as Nolténus states, the absolute perfect participle of other verbs (*comperto*, *excepto*, etc.) can be found also in Classical Latin.

caeteris paribus] The phrase is a technical term in scholastic and later scientific Latin (cf. *DMLBS*, s.v. *ceterus*, 2; and *OED*, s.v. *ceteris paribus*), and it is still today relevant especially within the fields of philosophy and economics. Micraelius (1661, col. 227) simply says that it applies to instances in which there is a comparison between some things, and one of them exceeds the other in a certain respect: *quando inter quaedam sit comparatio, et unum alterum excedit certo respectu*.

20. **unae post alteras]** The construction is late Latin (cf. Forcellini, s.v. *unus*, 17), and accordingly regarded as bad Latin in both Nolténus (col. 1812) and Krebs & Schmalz (s.v., *unus*, 4).

duplicis potissimum generis] As we can see in the next thesis, these two kinds of instruments represent the two ways in which sound is created in general. Notably, percussion instruments belong to the latter mentioned

category, in which sound does not come about from a motion of the instrument itself. Cf. the account of the different kinds of instruments in Mersenne, where these are included as well (1648, p. [ii]1): *Singulas Instrumentorum species, tam quae nervis, seu chordis, instruuntur, quam quae inflantur, et inspirantur, aut percutiuntur, enumerare et dividere*. Most commonly, however, musical instruments are divided into three different groups: string, wind and percussion instruments (cf. e.g. Vallerius / Bergrot 1717, p. 3).

adaptantur] The word *adapto*, which only occurs twice in Suetonius in Classical Latin, should here be understood in the sense of *apto* (cf. *OLD*, s.v. *apto*, 4, b).

21. **pulsantur]** The verb *pulsare* is used for playing instruments in Classical Latin (*TLL*, s.v. *pulso*, 2607, 16 ff.), but then rather narrowly about playing by ‘striking’ in one way or another, on string instruments, drums, etc. In the Middle Ages, however, the usage is extended to other instruments, most notably the organ (Blaise [2], s.v. *pulso*, 1; *GMO*, s.v. *pulsator organorum*). In Vallerius we thus also find *pulso* when playing bow instruments, such as fiddles (thesis 70 below) and keyed fiddles (thesis 103 of *De modis*).

22. **sphaeroidem]** The word occurs as an adjective in Vitr. 8.5.3, in the sense of ‘spherical’, and then as a noun first in the 5th-century author Claudianus Mamertus (Forcellini). It is absent from several lexica contemporary with Vallerius (e.g. JPG, BFS and Noltenius), although Matthiae accounts for it, as an adjective. But in other sources of the time it can be found as a noun as well (cf. Latham, s.v. *spheroids*, and *OED*, s.v. *spheroid*).

23. **operatio]** Once again we meet a philosophical *terminus technicus* (Blaise [2], s.v. *operatio*, 2; *DMLBS*). In Micraelius (1661, col. 929) it is explained as the dependency of the effect on an agent, viz. the act in which the agent exerts his power (*dependentia effectus ab agente: actus quo agens suam potentiam exerit*). Micraelius also makes a distinction between practical and theoretical operations (cf. *OED*, s.v. *operation*, I, 1, a).

palmulam] The sense of ‘key’ occurs, for instance, in Mersenne (1648, pp. [ii]9 and 66 f.), and can be attested in several later lexica (e.g. Zedler and Adams; cf. also Huygens 1724, p. 750). When Kircher explains the construction of the keyboard of a harpsichord, he says that ‘the *abacus harmonicus* [keyboard], or *claviarium*, or *tastatura*, as the Italians call it, is nothing other than a music-theoretic system, arranged according to the musical scale from polyplectrous keys ...’ (1650, vol. 1, p. 454):

Abacus harmonicus, sive Claviarium, vel ut Itali vocant Tastatura, nihil aliud est, quam systema Musurgicum, secundum scalam musicalem ex palmulis polyplectris ita dispositum ...

polyplectri] Etymologically the word is made up of the Greek πολὺς ('many') and πλῆκτρον ('plectrum'), and the group of instruments referred to are thus the ones that render their sound with the aid of many plectra, such as harpsichords and spinets (cf. Adams). Kircher in the section with the heading *Polyplectrotechnia, sive de Instrumentis Polychordis* (1650, vol. 1, p. 452) starts by stating that a group of instruments that are *polychorda* ('with many strings'), like harpsichords, spinets, manichords and clavichords, 'consist of a keyboard made up from polyplectrous keys, which they generally call *claviarium*' (*Abaco ex palmulis polyplectris conflato, quod Claviarium vocant eruditiores, constant*). But also organs of course have a keyboard (1650, vol. 1, p. 506): *Abacus polyplectrus, sive Claviarium*.

24. **Mercenni ex Harmonia minore]** The reference again leaves much to be desired, it has to be said (in the original print, we meet the abbreviations *Harm. min.* here). Obviously, however, it points to section IV, entitled *De musica theorica et practica*, which is contained in the *Cogitata Physico Mathematica* (1644, pp. 261–370). For there we read in a heading that at least fifty vibrations of a string made in one second produce a sound that is unison with an organ pipe of eight feet, etc. (p. 273):

Quinquaginta ad minimum vibrationes nervi factae spatio unius secundi, hoc est $1/3600$ parte horae, faciunt sonum unisonum cum fistula Organica octupedali, seu cum tubo aperto 8 pedum, vel quadrupedali obturato.

Some few lines below on the same page, we read in Mersenne that when a string is so loose or thick that it vibrates only sixteen times in one second, the sound created can hardly be noticed at all:

Porro cum nervus adeo lusus, vel crassus est ut spatio secundi 16 dumtaxat recurat, seu tremat, vix auditus ullus de illo sono iudicet, quod vel non audiatur vel illius gravitas nimia sit.

As we can see here, the entire thesis no. 24 in Vallerius's dissertation is made up of a two reworked passages from Mersenne.

As regards the value of frequency for pitch in Mersenne, however, one must also remember that he often contradicts himself on this point in different parts of his works (cf. Hunt 1978, p. 93 f.). In *Harmonie Universelle* he writes, for instance (1636–1637, book 3, pp. 140 f.):

... la chorde, qui est à l'unison d'tuyau d'Orgue de 4 pieds ouvert, fait 48 retours dans l'espace de la trois mill sixcentiesme partie d'une heure, c'est à dire dans l'espace d'une seconde minute.

secundo ... minuto] Both second and minute are of course neologisms in relation to Classical Latin. But while *minutum* is attested in this sense as early as Augustine (*TLL*, s.v. *minuo*, 1043, 45 ff.; cf. Solvang, s.v. *minutt*), *secundum* can be found as 'a second' (the second part in relation to the minute) first in the high Middle Ages (*LLNMA*, s.v. *secundus*, II, B, 2; Niermeyer; cf. Solvang, s.v. *sekund*), due to the refined methods of measuring time. Notice that Vallerius always writes it as *secundum minutum*.

fistula organica] While an *organum* with pipes is described as early as Pliny the Elder (*TLL*, s.v. *organum*, 972, 6 ff.), the adjective *organicus* as referring to that instrument appears in Isidore (*TLL*, s.v. *organicus*, 967, 46 ff.). Walther (s.v. *fistula organica*) accordingly translates it as *Orgel-Pfeiffe* (cf. Blaise [1], s.v. *organicus*).

octupedali, seu cum tubo aperto 8 pedum] The sense of *octupedalis* is 'of eight feet', as Vallerius here demonstrates clearly by the explanatory clause. It is obviously a neologism, although occurring also for example in Mersenne 1644 [2], p. 53.

The main difference between open and closed organ pipes is of course that the latter are closed at the top: *Fistulae clausae in duobus differunt a fistulis apertis; Primo, quod vertex ipsarum obturatur ...* (Kircher 1650, vol. 1, p. 507).

25. **tradit etiam Mersennus]** Mersenne treats this subject, and establishes this same proportion of 19 to 20, in the *Harmonicorum libri XII* (1648, p. 25): 'the diminution of the movements of the previously mentioned string follows almost the same proportion, which is 19 to 20' (*diminutio recursuum chordae praedictae eandem fere proportionem observat, quae est 19 ad 20*). The statement occurs in the second corollary of a proposition aiming to define 'the principle of the spaces, through which the movements of a given string travel from the first and largest, to the last and smallest' (*Definire rationem spatiorum, quae percurrunt chordae datae recursus a primo maiori usque ad ultimum minorem*).

26. **(Claver)]** Vallerius here particularly associates the Swedish word in the parentheses, which is easily recognized as related to the German *Klavier*, with polyplectrum instruments. This finds support in the later common usage of *Klavier* regarding the clavichord (e.g. Vallerius / Bergrot 1717, p. 22: *Clavichordia, quae a nobis klawer dicuntur*). It could certainly otherwise also refer to the keyboard of keyboard instruments quite generally, the organ included (*GMO*, s.v. *Klavier*, 2; and *MGG*, vol. 5,

cols. 283 f., cf. Walther, s.v. *claviatura*; Hülphers 1969[1773], pp. 79 f. and Mersenne 1648, p. [ii]118).

Chelyum] It is not easy to determine the exact designations of string instrument names from this time. My intention here is thus mainly to figure out how Vallerius himself refers to them, by comparing the instances where they occur in the dissertations.

To begin with, we notice that *chelys* must be able to embrace both the violin (*chelys minor*, *De sono*, CXI) and the keyed fiddle (*chelys vulgaris*, *De modis*, CIII), but also the *testudo*, *lyra* and *tuba* (on which see below). We can therefore here safely establish a very wide meaning, that of ‘an arched string instrument’ (*chelys* will, however, be left without translation in the text). This can also be supported in earlier usages. It previously referred to ‘any stringed instruments’ (*LML*, cf. *GMO*). Praetorius, however, had thus begun his section on the lutes by rendering *chelys* as an alternative name for the wider term ‘lute’: *Die Lauten (Testudo, Chelys, Italis Liuto) haben anfangs nur vier Chor mit doppelten Saiten ...* (Praetorius 1619, II, p. 49). *Chelys* is explained by Athanasius Kircher, in a section with the heading *De chelybus, sive Violis*, as ‘every instrument ... which consists of a belly and a neck ... and which is played with a plectrum, or with a bow made from horse-hair, while the fingers of the left hand, which holds the neck, press the strings firmly’ (1650, vol. 1, p. 486):

... omne illud instrumentum ... quod ventre et collo ... constat, et quod plectro, sive arcu ex equinis setis constructo incitatur manus levae collo applicatae digitis immediate chordas prementibus.

The inflection of the Greek loan word *chelys* caused difficulties for Latin authors, both in ancient and in early modern texts. The plural genitive form *Chelyum* cannot be attested in ancient Latin, but only the nominative, accusative, ablative and vocative [sic] forms of the singular (*TLL*). In literature contemporary with Vallerius, however, we find it in many places, e.g. in Gaspar Schott’s *Mechanica hidraulico-pneumatica* (1658), p. 438. At other instances in Vallerius’s dissertations we also find the striking singular genitive *chelis* (*De sono*, LXXXI) and the ‘Classically correct’ accusative *chelyn* (*De modis*, CIII).

Violarum] The second term appears to be somewhat narrower than *chelys*.

We notice, however, in the discussion of thesis CXII of *De modis* that the *viola* according to Vallerius can be both fretted and without frets. The *viola* must thus embrace instruments of both the viol- and the violin-family, according to how we understand these instruments (cf. e.g. Gouk 1999, pp. 120 ff.). The term *viola*, which will also be left without translation in the text, was in constant development in the early modern period (cf. Hülphers 1969[1773], p. 84; *GMO*, s.v. *viola*, 2; and *MGG*, s.v. *Viola*). Walther later explained *viola* as *eine Alt- oder Tenor-Geige*.

Testudinum, Lyrarum] As Walther remarked (s.v. *chelys*), the *testudo* and *lyra* (together with *chelys* and *cithara*) can often designate the same instruments, the names then only referring to a difference in size. The *testudo* is generally ‘lute’ (Walther; *GMO*; Mersenne 1648, p. [ii]9; Kircher 1650, vol. 1, p. 476; Vallerius / Bergrot 1717, p. 29; and Hülphers 1969[1773], p. 82), while *lyra* is used for various instruments with strings, e.g. the harp (JPG, BFS, Matthiae) and the hurdy-gurdy (*GMO*, s.v. *Lyra* (ii)).

instrumenta pneumatica] The instruments referred to here are certainly the many different ones in which sound is created from air (cf. Hülphers 1969[1773], p. 84; and Kircher 1650, vol. 1, p. 496: *omnia ea organa, quae spiritu et vento animantur*).

calamis] At this instance Vallerius uses *calamus* as a technical term for the reed in reed-instruments (cf. *GMO*, s.v. *reed*), singling out these instruments from the other pneumatic ones.

tibiae lingulis] The word *tibiae* is the general name for ‘pipes’, and has been used for organ pipes since late antiquity (Blaise [2], cf. Walther, and *GMO*, s.v. *organ stop*), while *lingula* is the technical term for the tongue (cf. *OED*, s.v. *tongue*, 14, c) or reed of a pipe or flute (cf. *GMO*, s.v. *aulos*, I, 5, iv; *MGG*, vol. 7, cols. 897 ff.; Mersenne 1648, p. [ii]116; and Adams, s.v. *lingulae*).

(Schnarrwärrck)] The vernacular word explains what is referred to with the *in organis tibiae lingulis ... construuntur*. The fact that the tongue is here mobile is not mentioned explicitly (cf. thesis XXXI below), but can only be grasped with the aid of the word in the parenthesis. This is the German *Schnarrwerk*, that is, rattling stop (cf. *GMO*, s.v. *Schnarrwerk*), which in Zedler (s.v. *Schnarr-Werck*) is described as:

... alles Pfeiffen-Werck, so nicht als Flöten gehet, sondern daran ein messingenes Zünglein durch den Wind auf die Röhre gedruckt wird, worauf es einen schnarrenden Laut machet ...

In Vallerius / Bergrot (1717, p. 18) *Schnarrwärrck* is likewise described as ‘pipes that sound in a vibrating motion, because of tounges’ (*fistulae motu vibratorio sonantes, propter lingulas*).

27. in considerationem non venit] The construction *in considerationem venire*, which is so common in dissertation prose, occurs first in the Middle Ages, e.g. in the *Collationes in hexaemeron* (2.1.5) of Bonaventure, in analogy to expressions as *in mentem venire* (*OLD*, s.v. *venio*, 12). Cf. the discussion on meta-textual constructions in section 1.5.2 above.

28. Nec ullum Musurgicum ... inveni] Vallerius thus did not know of any scholar who had treated the creation of sound in pipes, but of course such

attempts had already been made, for instance by Isaac Beeckman at the beginning of the century. In his view the air that is blown into a pipe is cut into small globules by the edge at the opening of the pipe. Pitch then depends on the size of the globules, and their size in turn depends on to what degree the surrounding air checks the spreading of the globules (Beeckman 1939, pp. 305 ff., summarized in Cohen 1984, pp. 147 f.).

musurgicum] While *musurgus*, from the Greek μουσουργός, at the time means ‘musician’ or ‘composer’ (Walther, Adams, cf. Matthiae), I have not been able to attest the form *musurgicus* as a noun in any other source. Considering the context, we must assume that the term refers to a musical philosopher or theorist, one who investigates into the nature and principles of music and sound. This is also confirmed in *De tactu*, VII, where the authors contrasts music theorists and practicing musicians: *apud Musurgicos et Practicos*.

ex accidenti] As we saw above, *accidens* in philosophical terminology refers to the occasional or non-essential properties of a thing, as opposed to *substantia*. Micraelius (1661, col. 18) accordingly describes it as that which affects something besides the essence: *quod extra essentiam aliquid afficit*. Using the phrase *ex accidenti*, Vallerius thus says that the previous philosophers have scrutinized the matter only superficially.

saltem] While Noltenius (col. 1156), due to an alleged occurrence in Pliny, is somewhat suspicious as to the correctness of *saltem* in the sense of *solum* or *tantum*, which we meet here (cf. *LLNMA*, s.v. *saltem*, 1, b; JPG and Matthiae), Krebs & Schmalz do not hesitate to state that this signification is not ancient at all (cf. Forcellini). BFS likewise writes: *Male vulgus usurpat pro solum*.

Quomodo ... de hoc minime solliciti sunt] Mersenne, for instance, whom Vallerius follows, touches upon the subject of the creation of sound in pipes at several instances, but in one short proposition only accounts for some very preliminary and rudimentary reflections, and states that the question is a very difficult one: ... *qua ratione fiat sonus ille, eique hoc aut illud acumen contingat, non mediocrem difficultatem videtur* (Mersenne 1648, p. [ii]126).

Also Kircher is very brief on this subject, but states some general facts about the many different kinds of wind instruments (1650, vol. 1, p. 496). As regards pitch, it is with pipes as with strings, he contends. A motion of a string twice as fast brings about the octave, likewise ‘a striking of air that is twice as dense around the tongue of the instrument’ (*aeris duplo spissioris circa lingulam instrumenti illisio*) produces the octave. The material of the pipe greatly affects the sound, as do very small inequalities on its surface. The different shapes of the pipes, as regards length, width and disposition of the openings likewise make the sound different. Therefore there is also a great variety of different pneumatic instruments.

29. **tremulos]** In Pliny the Elder the adjective *tremulus* is in fact sometimes used as a noun, but then it refers to the trembles of human limbs, ‘a shaking or trembling in the joints’ (L&S; Forcellini). Here the trembles are of course vibrations in the air.

resistentiam] The word is late Latin, first occurring in Augustine in the sense of *repugnantia* (Blaise [1], Souter, cf. Noltenius, col. 711, and Krebs & Schmalz). As a technical term in philosophy, Micraelius describes it as a hindrance, by which an agent is delayed in the action: *impedimentum, quo agens ab alio retardatur in agendo* (Micraelius 1661, col. 1219).

30. **profunditatem]** The word is late Latin, and first attested in Tertullian (Blaise [1]; *TLL*; Krebs & Schmalz, Noltenius, col. 686). Vallerius himself explicitly defines the sense as ‘pitch’ in thesis 34 below (*circa profunditatem, seu acutum et grave*), probably in analogy with the usage of the word for one of the three dimensions (‘depth’), which is also a technical term within geometry (cf. *TLL*, s.v. *profunditas*, 1739, 49 ff.). For a long time, however, *profunditas* only referred to ‘low pitch’, for example in Johannes Lippius’s *Synopsis musicae novae ...* (1612, fol. B6r): *omnis sonus ... est aut Profundus seu Gravis, aut Altus seu Acutus*. Lippius instead uses *crassitudo* for ‘pitch’. Cf. the description in Bellman / Vallerius (1706, p. 2): *Profunditas seu crassitudo, quatenus est vel alta et acuta, vel humilis ac gravis; grant eller groft*.

latitudinem] As regards the translation ‘volume’ for another of the three dimensions of sound, cf. Walther, s.v. *latitudo soni*, and Lippius 1612, fol. B5v. Vallerius himself accordingly says in thesis 44 below: *dico in hac sola vibrationum quantitate omnem soni latitudinem tantum consistere*, and in 45: *majorem habebit latitudinem, id est longius audietur*. In thesis 5 of the dissertation *De tactu* below, Olaus Retzelius likewise explains the term as: *sphaera illa maxima, intra quam sonus audiri potest, seu totum illud spatium ... per quod corpus aliquod motum suis prorsus similes aeri vibrationes imprimere valet*. In Bellman / Vallerius (1706, p. 2) it is described as concerning whether the sound is stronger or weaker (*Latitudo dicitur, quatenus est vel intensior vel remissior; ett hårdare eller sacktare liud*).

clavem] As we can see, *clavis* here must mean ‘tone’. For an exhaustive treatment of the different concepts of *clavis* in music history, see *HMT* (cf. *LML*, *GMO*, s.v. *clef*, and Walther, s.v. *chiave*).

sedes] We find *sedes* used in several different senses in the history of music theory. Besides in the medieval *sedes troporum* (on which see *GMO*, s.v. *mode*, §II, 1), we notice the word in Friedrich Beurhaus’s *Erotematum musicae libri duo*, for instance, where it refers to the position of the tones in the staff, and this was apparently common. The *sedes sonorum* is explained as the lines, and the spaces inbetween the lines, by which

sounds are written out with their symbols (1580, vol. 1, p. 23): *Lineae et inter eas spacia sunt sedes et receptacula, per quae soni suis symbolis notantur*. Glarean in his *Dodecachordon* had likewise written that musicians call the positions (*sedes*) of the voices tones (*claves*), which are distinguished by line and space in songs (1547, vol. 1, pp. 1 ff): *Sedes autem harum uocum clauis nominant [musici] distinctas linea ac spacio in cantibus*. Lippius would later simply state that *sedes* can be the musical staff: *Sedes est Systema Musicum* (1612, fol. D5v; the same is stated in Gezelius 1672, p. 567).

On the other hand, Glarean had also clearly used *sedes* in the sense of ‘final’ (1547, vol. 1, p. 31): *Quamuis enim primi ac secundi modorum sedes sit D sol re ...* (‘For although the final of the first and the second mode is D, sol re ...’).

Considering the context in Vallerius’s text, however, we can safely assume that *sedes* here refers to the lowest tone of the pipe under discussion, or even to the position in the staff of this natural tone. The pipe first (*prius*) resounds the tone F, since its place (*sedes*) is there. While *sedes* is to be understood as the ‘foundation’ (cf. L&S, s.v. *sedes*, II, C), *prius* refers to the initial state when the pipe is unaffected by external impact. Cf. thesis 37 below, where it is stated that the tone *f* is the lowest in pipes.

grave ... superius ... excellens] The terms express the registral location of each tone attached to it, and obviously correspond to the *gravis*, *acuta* and *superacuta* as these were used in hexachordal solmization (cf. e.g. Cohen 2002, p. 342 ff., and Barnett 2002, pp. 408 ff.), although Vallerius’s very words are more closely related to the earlier tetrachordal registration. The word *excellens* was attested in the sense of ‘the tones of the highest tetrachord’ in Martianus Capella 9.944 (cf. *TLL*, s.v. *excello*, 1217, 1 ff., and Adams), while *gravis* and *superior* had been used for defining registers at least since the Middle Ages. We find them, for instance, in Aribio’s (fl. c. 1068–1078) *De musica*, where it is said that ‘when the tropes [of the tetrachords] have been separately arranged we see more clearly how the protus and its plagal consists of the first of the *graves*, i.e. A, the first of the *finale*s, i.e. D, the first of the *superiores*, i.e. a, the first of the *excellentes*, i.e. d.’ (1951, p. 2):

Dispositis separatim tropis [tetrachordorum] evidentius intuemur, qualiter protus cum suo subiugali constet prima gravium, id est A., prima finalium, id est D., prima superiorum, id est a., prima excellentium, id est d. ...

momentum] The word is a scientific *terminus technicus* at the time. Kircher (1650, vol. 1, p. 416) accordingly defines it as ‘an excess of moving potency, beyond the impediments of the motion’ (*excessus virtutis moventis, supra motus impedimenta*).

31. **Cornett]** Apparently Vallerius considered *cornett* to be equivalent to ‘all kinds of horns’, and this could seem somewhat surprising considering its common signification at the time. Walther (s.v. *cornetto*) explains it either as *ein Zincke* (Eng. ‘cornett’, not to be confused with the ‘cornet’ that was invented in the 1820s, cf. Hülphers 1969[1773], p. 85; *GMÖ*, s.v. *cornett* and *cornet*; and *MGG*, vol. 9, cols. 2383 ff.; but also Adams, s.v. *cornet*), or as *ein kleines Jäger-Horn* (Walther, s.v. *cornet*, cf. Adams, s.v. *cornetto*). Praetorius likewise explains *Zincken* as *Italis Cornetti, et fortasse Latinorum Buccinae alias Cornua* (Praetorius 1619, II, pp. 35 f.). In Kircher *cornu* is said to be *cornetto* in Italian (1650, vol. 1, pp. 500 f.). We should thus rather consider the instrument mentioned only as an example of the horn-family.

particularibus] The word is late Latin (Blaise [1], *TLL*), and accordingly not recommended in Krebs & Schmalz and Noltenius (col. 647). The latter characterizes it as typical of dialectic discourse, where it is opposed to *universalis*.

castanetis] Originally a *castanetum* is a chestnut plantation (*OLD*), but here the word certainly refers to the instrument castanets (cf. Walther, s.v. *castagnettes*). A similar instrument was used in ancient Rome and in the Middle Ages (there are extant pictures of it from the late 13th century), but in the 17th century they are especially associated with *die Mohren, Spanier und Böhmen* (Walther, cf. *GMÖ*, s.v. *castanets*; *MGG*, vol. 5, cols. 170 ff.; and Mersenne 1648, pp. [ii]161 f., where it is spelt *castagne-tae*).

33. The thesis is close to prop. 36 in the second book of Mersenne’s *Harmonicorum libri XII*, and Vallerius uses exactly the same picture as Mersenne. Vallerius’s aim is to demonstrate how different frequencies of vibration in strings are exactly proportioned to each other according to their length, tension and thickness, which Mersenne had been the first to show in 1635 (Gouk 1991, p. 105). Mersenne likewise writes on the causes of different pitches that the more movements here and there a string performs in the same period, the higher it sounds, and this is always true, regardless of whether the string is longer and thicker, or shorter and thinner (1648, p. 27):

... nam quo nervus eodem temporis spatio plures recursus habet, eo sonat acutius; quod semper verum est, sive nervus iste sit longior, et crassior, sive brevior, et tenuior.

Mersenne, however, also wanted to contradict the idea that a string emits a lower sound at the end of its motion (cf. the heading of the proposition: *Definire num graviorem sonum nervus in fine, quam in initio sui motus*

edat, cum tardius moveatur, et unde acumen), and this question Vallerius deliberately omits (*Ad velocitatem vibrationum vero nunc non attendo*).

34. **numeros radicales**] While the adjective *radicalis* is late Latin (Blaise [1], Souter), the use of *radix* for square roots in mathematics appears in medieval Latin (cf. Latham), in the 12th century (Solvang, s.v. *rot*; Tropfke, vol. 2, p. 144). Micraelius (1661, col. 1199) accordingly describes it as: *radix in arithmetice est latus figuratorum numerorum*. As regards the usage of the term in music theory at the time, see Walther, s.v. *Numeri radicales Consonantiarum et Dissonantiarum*, and *Numeri radicales Harmonici*. The actual term *numerus radicalis* can for example be attested in the 14th century author Jacobus Leodiensis (1955, p. 217).
36. (**vulgo Chormässigh**)] The Swedish word *Chormässigh* is explained by the Latin phrase *consonantia instrumentorum communis*, but it also adds precision to it. Walther (s.v. *choro*, 2) accordingly explains *chorus* as: *Denjenigen Theil eines musicalischen Stücks, worinn alle Stimmen zusammen, und mit einander zugleich gehen*. Thus *chormässigh* is ‘in the manner of a choir’. See further the commentary on *De modis*, CXV, where Vallerius instead uses the Latin *concentus universalis* for the same phenomenon. Later in that dissertation he also uses this Latin term without the vernacular addition.
37. **Deinde unicuique ... praecise resonare**] In Descartes’s *Musicae compendium*, for instance, the same fact is stated. If you inflate a pipe with more force than necessary, it will emit a sound that is an octave higher (1978, p. 12): *in fistulis experimento comprobatur, quae si validiori flatu inspирentur quam solent, statim una octava acutiorem edent sonum*.
- Diapason**] The *diapason*, from the Greek διὰ πασῶν (*χορδῶν*), literally ‘through all (strings)’, occurs in Vitruvius to designate the interval of an octave (*OLD*). This is accordingly its name, since *sie alle intervalla simplicia in sich begreiffet* (Walther). Kircher, and many other with him, labels it *octava perfecta* (1650, vol. 1, p. 100; and vol. 2, p. 209), while in Bellman / Vallerius (1706, p. 18) it is called *octava perfectissima*.
- Diapente**] Likewise the *diapente*, from the Greek διὰ πέντε (*χορδῶν*), literally ‘between five (strings)’, can also be found in Vitruvius designating the interval of a fifth (*OLD*). Walther explains it as *eine vollkommene, oder reine Quint, aus drey gantzen und einem unvollkommenen Tone bestehend*. Kircher also calls it *quinta perfecta* (1650, vol. 1, p. 98), while in Bellman / Vallerius (1706, p. 18) it is called *omnium consonantiarum jucundissima* (‘the most pleasant of all consonances’), similar to the view of Descartes (1978, p. 22).

38. **addebatur**] The imperfect tense may surprise at this instance. Probably we should understand it as referring to repeated experiments in the past, in other words ‘during the experiments’.

39. Vallerius made a mistake when accounting for the overtones in the staff in this thesis. The sixth overtone has been mixed up with the third pure octave tone (cf. Moberg 1929, p. 69). Vallerius’s description, however, agrees with both Kircher and Mersenne (see below), while it does not with modern acoustics, in which the 5th overtone is a flattened 7th, in this case b^{b1} .

tubae bellicae] War trumpets belong to the group of trumpets without fingerholes, slides or valves, which are called ‘natural trumpets’, in contrast to the chromatic ones (as regards its history, see e.g. Bate 1978, pp. 106 ff.). That term even echoes when Vallerius some lines later talks about the war trumpet: *Estque hoc ipsi tubae adeo naturale*.

notulas] The word is late Latin, first being attested in Martianus Capella (Souter, L&S). Regarding musical notation it naturally appears in medieval Latin (*DMLBS*, s.v. *notula*, 3; Blaise [2], s.v. *notula*, 1).

primo per octavam ...] Mersenne and Kircher explain the intervals of a natural trumpet somewhat differently. There an octave is brought about in the first step. Thereafter follow a fifth and a fourth. Then a ditone, a minor third, and once again a fourth. The last octave is divided into the remaining intervals, in accordance with the diatonic series (Mersenne 1648, p. [ii]105; and Kircher 1650, vol. 1, p. 502). As we can see when we compare Vallerius’s words with Mersenne’s, Vallerius does not have the minor third. But since this is correctly indicated in the illustration, there must simply be a mistake by Vallerius in the text here.

tibicinis] We would here rather than *tibicinis* (‘flautist’) in the printed text have expected *tubicinis* (‘trumpeter’, cf. Walther, Adams), which is quite obviously the intended sense in this context. It might be a simple misprint, but *tibicen* might also have been regarded as a wider term for persons playing wind instruments. In any case, the translation renders ‘trumpeter’.

hanc ob causam] In Mersenne the explanation of why the intervals between lower sounds are greater is somewhat different. Lower sounds, and those which are generated from a softer percussion of the air, can be divided into smaller parts with greater difficulty than higher sounds, and those which are emitted from a dryer body. The parts are thus more and smaller in proportion to the dryness of the sound (Mersenne 1648, p. [ii]105).

Diatessaron] Just as with the *diapason* and *diapente*, the *diatessaron*, from the Greek διὰ τεσσάρων (χορδῶν), literally ‘between four (strings)’, can be found in Vitruvius for the interval of the fourth (*OLD*). Walther explains it as *eine vollkommene oder reine Quart, aus zwein gantzen Tonen, und einem Semitonio majori bestehend*. According to Kircher, it can also be called *tetrachordum*, *numerus epitritus*, *minima consonantia*, *prima*

symphonia and *prima harmonia* (1650, vol. 1, p. 98). See further Braun 1994, pp. 180 ff.

... **si minus placuerit, meliorem ... expectabo**] Vallerius' words of humility could again be considered as an example of the rhetorical device of *recusatio* (cf. section on language and style above). However, this way of also encouraging other and better explanations and treatments of a certain subject, if there should be any, also has parallels in other music theoretical literature of the time. In Burmeister's dedication of his *Musica poetica* we read, for instance, as a humble comment on his own work (1993[1606], p. 6): *qui uberiora et meliora praestare possit, eum exemplo meo incitare vellem* ('the one who could achieve anything richer and better, I would like to encourage with my example').

40. **nunquam unum simplicem, sed semper plures simul sonos**] The question of why some bodies, e.g. strings and bells, produce multiple sounds was much debated at the time. In a letter to Mersenne from 1630 Descartes had suggested that some parts move faster than others in sounding bells (Palisca 1961, p. 98). Mersenne also adduces this argument in his discussion of the phenomenon (1648, p. [ii]159). Vallerius's explanation has similarities to Mersenne's but is shorter and leaves no room for alternative solutions. Vallerius has also added the observation on what happens when you strike the bell harder and harder. Multiple sounds in strings will return below in thesis 78.

Quod idem observare licet in vitris] The thesis could be compared to a passage in Daniel Georg Morhof's (1639–1691) *Epistola De Scypho Vitreo per certum humanae Vocis sonum rupto ad V. Cl. Johannem Danielema Maiorem ...* (1672). There it is first stated that cups of glass, just like bells, produce several different tones at the same time in their different parts, because of the diversity of their shape (fols. C4–D1):

Accidit etiam in scyphis vitreis, ut pro diversitate figurae diversi sint soni, quemadmodum in campanis ... fieri videmus. Omnes enim plures habent tonos, aliterque sonant cum in margine extremo, aliter cum in medio, aliter cum in apice pulsantur.

Some lines later, when Morhof has compared the sound created by voices in cups of glass with that in tables of glass, he states that the latter could be broken by a voice just as the former. For a table of glass sounds just as strongly as a cup of glass, especially if one has the mouth close to the center of the table. For the sound is weaker in its other parts.

Nec dubito, quin eodem modo rumpi tabula possit, quo scyphus, aequae enim fortiter ac scyphus sonat, praecipue si os centro tabulae admoveas. In caeteris enim partibus tenuior sonus est.

41. **clavulo]** This sense of *clavulus*, a diminutive of *clavus*, must refer to the tuning peg, considering the context. This sense of the word can also be attested in other contemporary musical texts. In Johannes Cochlaeus's *Tetrachordum musices*, for instance, we can read about the lute: *chordae ... per collum protenduntur subiectis quibusdam clauulis* (Cochlaeus 1514, fol. AVIv).

42. **ellipsin]** Here the word, from the Greek ἔλλειψις, certainly refers to the mathematic technical term, which Micraelius (1661, col. 431) explains as 'a curved line in a transverse section of a cone or cylinder, which neither touches the base, nor the top' (*ellipsis geometris est linea curva in transversa conii vel cylindri sectione, quae nec basin tangit, nec verticem*). The word has its origins among the Pythagoreans, although Apollonius of Perga (3rd century BC) was the first who used it in the sense intended here (Solvang, s.v. *ellipse*). In ancient Latin, however, the word is only attested in the grammatical and rhetorical sense (*TLL*).

per 52 tertii Conicorum Apollonii] The *Conics* of Apollonius of Perga (c. 240–190 BC) is in fact one of the most important scientific works from antiquity. Being well-known in the Islamic world as early as the Middle Ages, it came to be immensely influential on the mathematical sciences in Western Europe after its rediscovery during the Renaissance (first printed in Latin in 1566). In a modern edition consulted (the Teubner edition of J. L. Heiberg), we find the section Vallerius refers to in paragraph 53 of the third book (for a general summary of the theories presented in the *Conics*, see e.g. Katz 2009, pp. 114 ff.).

43. **nervus ... prope magadium pulsetur]** Worth noticing is that Mersenne's opinion differs in this respect. He thinks the sound that is produced from touching a string in its middle is sweetest, because of the greater uniformity and evenness of the motions of the string there (1648, p. 47): *... demonstrat illum sonum omnium esse gratissimum, qui ex tactu circa medium oritur, maior enim tunc est motuum chordae uniformitas, et aequalitas*.

The word *magadium*, which is the Greek μαγάδιον (diminutive of μαγάς) with the same sense (cf. Liddell & Scott), is explained in Walther as: *auf besaiteten Instrumenten der also genannte Steg, worauf die Saiten ruhen, und ohne welchen sie nicht klingen können*. As *magadia* (-ae) it is attested in medieval Latin (*LLNMA*). The form *magadium* can e.g. be found early in the *De arte canendi* of Sebaldu Heyden (1540, p. 7).

45. **modo remittitur modo intenditur]** The words *remittere* and *intendere* are used for lowering and raising the pitch in Classical Latin (cf. *TLL*, s.v. *intendo*, 2114, 69 ff.; Lippius 1612, fol. C2r; and Walther, s.v. *intentione* and *remissio*; see further Bower 1989, p. 11). This is connected to the

production of sound in strings and in wind instruments, which is also clearly recognizable in theses 35 and 39 above.

55. apud Varenium exstat in *Geographia Generali* l. 1. prop. 41] The *Geographia Generalis* by the German geographer Bernhard Varen (1622–1650/51) after its first publication in 1650 remained a standard authority in geography for more than a century, although it was also frequently revised. More precisely Vallerius referred to book 1, section 5, chapter 19, proposition 41. The *propositio* has the heading *Aër in quibusdam locis quaedam habet peculiaris* ('air has certain peculiar properties in certain places'), and Varen there proves his statement in several examples, among others from lofty mountains (Varen 1672, pp. 248–251).

Hermetice sigillato] The word *Hermeticus* is coined in the Middle Ages (cf. *DMLBS*, Matthiae), and frequently used as an adverb with *sigillatus* ('sealed'), in the sense 'airtight closure of a vessel' (*OED*, s.v. *hermetic*, 2, b; cf. s.v. *hermetically*, 1, a, first attested in 1605). The alleged inventor of this physical procedure was Hermes Trismegistos, and from whence comes its name. See further in Zedler, where the hermetic sealing of glasses at this time is described in great detail (Zedler, s.v. *Siegel (hermetisches)*).

Moreover, according to Krebs & Schmalz the word *sigillatus* is first attested from the 6th century in the sense of *siegeln, versiegeln* (mainly of letters), and later also in extended senses (cf. *LLNMA*, s.v. *sigillo*, B, 1, b). Nolténus (col. 729) thus disapproves of it as well.

videre est] As regards *est* in the sense of *licet*, which is what we meet here, cf. K.-St, I, p. 669; and Sz., p. 349.

apud Kircherum in sua *Musurgia*] Athanasius Kircher treats the question of sound in spaces empty of air in the first book of his *Musurgia universalis* (1650, vol. 1, pp. 11 ff.).

Mersenne in *Harmonia maiore Latina*] From the quotations of Mersenne that follow later in the dissertation (most clearly in thesis 56), we know that *Harmonia maior Latina* must refer to the *Harmonicorum libri XII* of 1648. Accordingly, we there find a treatment on the creation of sound in a vacuum at the beginning of the part named *Liber novus praelusorius*, an addition in the 1648 edition, on pp. 1 f.

Jeriche *De spatio vacuo*] Otto von Guericke (1602–1686), the German physicist and burgomaster of Magdeburg, deals with the question of sound in a vacuum in the third book of his *De Vacuo Spatio* (1672, pp. 91 f.). He became famous for his demonstration of the force of atmospheric pressure through the 'Magdeburg hemispheres'.

Robertum Boyle in *Experimentis Physico-Mechanicis*] Robert Boyle (1627–1691), the British natural philosopher, discusses the question of the propagation of sound in different conditions in the experiment 27 of his

Nova Experimenta Physico-Mechanica de Vi Aeris Elastica & ejusdem Effectibus (1661, pp. 138 ff.).

56. **Mersennus in sua *Ballistica***] Vallerius in this sentence summarizes the information given by Marin Mersenne in his *Ballistica et Acontismologia* (1644, pp. 138 ff.), in proposition 35 with the heading *Soni velocitas maior est globorum explosorum velocitate, et 230 sexpedas spatio unius secundi minuti conficit* ('the velocity of sound is greater than the velocity of cannon-balls, and travels through 230 fathoms in the space of only one second').

sexpedas] The word is probably a neo-Latin coinage, referring to the measure of 'six feet', or a 'fathom'. Mersenne uses *sexpeda*, *hexapeda* and *hexapoda* interchangeably in the same sense. The *hexapeda* is apparently the most common (cf. Hoven, Bartal, and Latham).

Leucam Gallicam] The *leuca*, or *leuga*, i.e. the French *lieue* or the English 'league', is a Gallic measure of distance that first occurs in an ancient inscription (*CIL.* 13.9031). Noltenius (col. 601) explains it as corresponding to *spatium mille et quingentorum passuum in longitudinem*, i.e. 1500 Roman paces (cf. *OLD*, s.v. *leuga*).

in suis *Harmonia minore*, Lib. 2] i.e. book 2 of the section *De musica theórica et practica*, contained in Mersenne's *Cogitata Physico Mathematica* (1644). There we read in a heading on p. 274: *Fidium, et organorum sonus spatio secundi, 230 hexapedas, seu 1380 pedes conficit*. Thereafter Mersenne refers to his other treatments of the speed of sound, both in the *Harmonie universelle*, the *Harmonicorum libri* and the *Ballistica*.

Harmonia majore Latina] The quotation is taken literally from Mersenne's dedication of the edition of *Harmonicorum libri XII* of 1648 (fol. aij), when he concludes that God's trumpet on Judgment Day will be heard all over the world within one day and night. The presence of these words thus makes it certain that Vallerius has used the 1648 edition, and not the first one of 1636.

Gassendus in *Philosophia Epicuri*] The work referred to is Pierre Gassendi's *Animadversiones in decimum librum Diogenis Laertii* (1649), where the author accounts for Mersenne's results from his studies on the velocity of sound (p. 280):

Quo loco tacenda non est Mersenni nostri observatio, qui velocitatem soni studiose emensus, deprehendit ipsum uno horae secundo pervadere ducentas triginta Parisinas Orgyias, seu hexapodas, ac uno proinde minuto horae primo, seu sexagesima horae parte, supra Orgyiarum quatuordecim millia.

Kircherus vero in *Arte magna Consoni et Dissoni*, lib. 9] The reference is accordingly to book 9 of Athanasius Kircher's *Musurgia universalis* (1650), where Kircher claims that sound travels 100 feet in one second,

and two *lieu* in one minute. Sound then travels around the entire world in 60 hours (vol. 2, p. 360):

Si tamen speculative sive mathematice de hoc negotio loquamur, et experientia in Echonica Musurgia doceat, sonum 100 pedes geometricos conficere spacio unius min. secundi, et consequenter 2 leucas spacio unius minuti 1. unius horae. Certum est huiusmodi vehementibus sonis circa universam terrae molem, instrumentorum vocalium distributione successive editis 60 horarum, id est biduo cum 12 horarum spacio, quicquid in universo mundo contigit, cognosci posse.

57. **unus ... alter]** Such a use of *unus* was rejected in Krebs & Schmalz (s.v. *unus*, 3), the alleged Classical variant being *alter ... alter*. Noltinius (col. 1812), however, calls such a construction *falso suspectum est Germanismi*, and with the aid of several examples defends it as correct Classical Latin (cf. *OLD*, s.v. *unus*, 9, c).

gaudet] The *gaudeo* in this weakened sense ‘have’ can be found in ancient Latin with the ablative, and most often with inanimate subjects. Thus it was used also in neo-Latin, and the expression there becomes especially common in scientific texts (Helander 2004, pp. 117 f., cf. Krebs & Schmalz).

Kircherus in *Arte magna Consoni et Dissoni*, lib. 9] The quotation has, with some slight unimportant adjustments, been taken from Kircher’s *Musurgia* (1650, vol. 2, p. 360). In the passage Kircher deals with what he calls *cryptologia*, i.e. how the ‘hidden concepts of the soul’ can be communicated to other people, among other things by means of very violent sounds (cf. Gouk 1999, p. 186).

Mersennus in *Harmonia majore latina*, l. 2] In book 2 of *Harmonicorum libri* (1648), we meet the passages literally quoted here on p. 31 in proposition 39, in the proposition that aims at defining at what distance a sound can be heard.

58. **tabula]** Vallerius is here speaking about the soundtable, or belly, i.e. the upper surface of the body of string instruments, as we can see from his description. That sense is, for instance, also attested in Mersenne (1648, p. [ii]9), and Walther (s.v. *table*), where it is explained as *die Decke, oder der Resonanz-Boden auf Instrumenten*.

clavulus ille ligneus] From Vallerius’s description, it is evident that the soundpost is referred to. Apparently, there was no proper technical term in Latin for it which he could use, or at least he did not know of any.

seorsim] The form, which is common in neo-Latin texts, is reproached as a false variant of *seorsum* in both Krebs & Schmalz and Noltinius (col. 159).

tympano Cylindrico (vulgo *Trumma*)] While *cylindrus* (from the Greek κύλινδρος) appears in Classical Latin, the adjective *cylindricus* is first

attested in neo-Latin (Hoven, Latham). The Swedish word *trumma* simply means ‘drum’ (cf. Swedberg), which is, of course, what *tympanum* refers to (cf. Walther).

tuba Marina (*Trumpet Marin*)] The instrument in question, the trumpet marine, is carefully described in Walther, and his description helps our understanding of the rest of the sentence (s.v. *tromba marina*, cf. Hülphers 1969[1773], p. 84; *GMO*, s.v. *trumpet marine*; *MGG*, vol. 9, cols. 971 ff.; and Mersenne 1648, pp. [ii]56 f.):

eine MarineTrompete, oder Trompeten-Geige, ist ein aus drey Bretern bestehendes, und, wie ein Triangul, unten etwas weit und offen, oben aber schmal zulauffendes Musicalisches Instrument, mit einem langen Halse, so starck auf dem Meer gebraucht wird, und davon den Nahmen bekommen. Hat nur eine starcke Darm-Saite, welche oben mit dem Fiedelbogen gestrichen, und mit dem lincken Daumen des Spielers an gewissen Orten angedruckt wird, da es denn, wie eine Trompete, aber sanffter und angenehmer klingt.

solet sonus insigniter adaugeri per varias curvaturas] The notion that sound is much increased in curved instruments is, for instance, extensively dealt with in Kircher’s *Musurgia* (1650), vol. 2, pp. 274 ff.

59. Mersenne also compares the swiftness of sound in a beam and in air in the first volume of the *Harmonicorum libri* (1648), where he states that ‘if the mass of the air should be as hard as that of a beam, it would not be strange that the sound produced in one part should instantly be perceived in the other parts’ (vol. 1, p. 32): *Si aëris moles trabis ... instar dura esset, non esset mirum quod sonus in una parte productus eodem in reliquis partibus momento perciperetur...* Cf. also Kircher’s description of the promotion of sound in tree trunks, in book 9 of the *Musurgia* (1650), vol. 2, pp. 273 f.

60. **Holmiae in monte Brunconis**] Brunkeberg, for which *Mons Brunconis* is the usual name in Latin (Helander 2004, pp. 45 f.), in the north part of Stockholm was for many centuries of great military importance. From there the roads approaching the capital from the North were guarded. The distance from Brunkeberg to Uppsala is approximately 55 kilometers.

61. **aqua fortis**] The multiword term for nitric acid appears among the alchemists in the Middle Ages, and thereafter also belongs especially to early scientific terminology (*DMLBS*, s.v. *aqua*, 5; *OED*, s.v. *aquafortis*).

Fahlunae] The town of Falun is situated in the Swedish region of Dalecarlia, in an area very rich with minerals. Important mines have been in use there ever since the Middle Ages. In Abraham Abrahamson Hülphers’s *Dagbok öfwer en resa igenom ... Dalarne år 1757* (‘Diary from a journey through Dalarna in the year 1757’) we find the claim that

the smoke originating in the copper-mines was at this time sometimes so thick in Falun that you could not see anything in front of you. Smoke from the smelting-works and dust from the mines also affected metal and buildings in the town: silver, copper and brass were made black by it, iron in free air became rusty, window-lead was consumed and glass made dusky (1910, pp. 286 f.):

Koppar-röken, (hwaraf Victriol, Swafwel och Rödfärg samlas) är ganska genomträngande, så att silfwer, koppar och meszing deraf swartna, järn i fria luften rostas, fönster-bly förtäres och glas göres dunkelt.

62. **Danielem Georgium Marhofium]** In the following section, we meet long quotations from the German polyhistor Daniel Georg Morhof's (1639–1691) *Epistola De Scypho Vitreo per certum humanae Vocis sonum rupto ad V. Cl. Johannem Danielem Maiorem ...* (1672), in translation 'Letter to the most brilliant man Johann Daniel Major about a cup of glass that was broken by a certain sound of a human voice'. As usual Vallerius's quotations are very close in sense, but not rendered exactly literally, and they leave out and reshape several sentences, not least by changing them into *oratio obliqua*. In Morhof we read (fol. D4r):

... quod in aedibus Musicis sibi vicinis aliquoties collapsum pavimentum fuerit: quod ipse sonis continuis adscribere non dubitavit.

According to Morhof, Thomas Willis had related this to him when they met in London, and Vallerius stresses this source as well. Then Morhof continues:

Scio alicubi in aede sacra fornicem angustiore, cui substructa erant organa Musica, una cum iis collapsum, quod factum forte ob multiplicem soni percussionem est, praesertim, cum et ipsi fornices sonare soleant ... Non raro tympanorum pulsu et tubarum sonitu templorum fornices concuti animadvertimus ... (fol. D4v) Impetus autem solus, ut in violenta aëris explosione, et incondito sono ipsis vastissimis aedificiis ac terrae tremorem incutit. Quod fieri videmus, cum tonitru auditur, aut bombardae majores exploduntur, a quo sono et aedificia contremiscunt et fenestrae franguntur. Solent et ova, quae aves foveant, eo rumpi, vel saltem ita pertubari, ne pulli excludi possint.

Here Morhof in his turn refers to some accounts made by Kenelm Digby:

Memorabilia sunt, quae refert Digbaeus *De Natura Corporum cap. 28. n. 3.* de scyphis vitreis, dum in navali praelio exploderentur tormenta, toto illo tempore trementibus, de papyraceis fenestris fissis, ac ovis, quibus columbae incubabant, confractis. Observavit ille fenestrarum in sua navi tremorem, cum exploderetur tormentum, in altera tanto intervallo distanti, ut visu vix detegi, ac sonus audiri potuerit. Refert simili occasione cursum navis suae se

mutasse, ut aliis pugnantibus succurreret eumque direxisse sono, vel potius motu seu tremore ex sono impresso, observato scilicet, quo in puncto pyxidulae nauticae tremor iste appareret, cum nihil quicquam audiret.

Interestingly, the sentence *De muris fanis ... dissilientibus* is lacking in Morhof. But Vallerius continues to quote the following page in Morhof (fol. E1r), which reads:

Solet et iste Sonus adeo movere minimas liquorum, vini et cerevisiae particulas, ut fermentantes vitium inde trahant, vel alia fermentatione corrumpantur. Cancrī etiam tonitru commoti foras prorumpunt.

Then Morhof refers to Scaliger's *Exercitatio* 130, a reference that Vallerius has rightly corrected to 180, where the author says that: *Tonitribus terram quati ac rariorem fieri existimat, ut tubera ex imbribus nasci possint*. Vallerius thereafter leaves out a section from Morhof, but quotes again when the German scholar relates a story that he has read in Henry Oldenburg (fol. E1v):

Porro huc referendum, quod in Actis Philosophicis Collegii Regii Anglici, p. 550. refert Nobilissimus Dn. Oldenburgius de quadam foemina, cui cum tonitru audiretur, semper laxata alvus, crebraeque fuerint vomitiones, quales nec a fortissimis effici medicamentis possint.

Having left out some sentences from Morhof, Vallerius continues to quote:

Quam ob causam abortire etiam cervas nonnulli credunt, (fol. E2r) cum tonitru audiunt adducti loco e Psalm. 28 et Hebr. 29.9. ubi tamen variant interpretum sententiae: quod et de conchis asserit Plinius lib. 9. cap. 38. Inter inconditos illos ac confusos sonos militaris itidem clamor est, cujus magnae etiam vires sunt, adeo ut ex aere aves in terram nonnunquam ceciderint ... de quo legantur Alexander ab Alexandro Genial. Dier. lib. 4. cap. 7. Elias Reusnerus in Stratagematogr. Gabriel Naudaeus de studio militari lib. 2. p. 494 ...

As we can see, Vallerius only mentions the first of the three authors referred to by Morhof (see further below, in the comments on Alessandro Alessandri). Vallerius now leaves out a large section from Morhof, but returns to him when he quotes the story of the eruption of Mount Etna in Sicily from Giovanni Alfonso Borelli (fol. E3v):

Aderam ... Tauromenii Siciliae, quando Aetna mons eruptionem quandam effecerat prope Ennam urbem fere 30. milliaria a Tauromenio distantem, tunc vicibus interpolatis eruptiones ingentes ignis vorago efficiebat grandi sono et strepitu, et tunc omnia Tauromeni aedificia, tremore concutiebantur.

collapsum ... fuerit] The shifted perfect passive, here *collapsum fuerit* for *collapsum sit*. See the notes on the phenomenon in the discussion of syntax in section 1.5.1 above.

ex Thoma Villisio] Thomas Willis (1621–1675), English doctor and iatrochemist, whom Morhof had met personally in London, as we saw above. Willis was professor in natural philosophy at Oxford from 1660.

tonitru] This nominative form is in ancient literature only attested in the grammarians (L&S, Krebs & Schmalz). Nonetheless it becomes common in neo-Latin, as one of those words of the fourth declension that were often regarded as *indeclinabile in singulari* (JPG, s.v. *tonitrus*, cf. Helander 2001, pp. 30 f.).

bombardae] The word is attested in the sense of ‘cannon’ in medieval Latin (*DMLBS*, s.v. *bombardus*; Blaise [2]), and this is what must be understood here. It may, however, also refer to guns, muskets, or even pistols. Petrarch was for a long time the alleged inventor of this word (Helander 2004, p. 177, cf. Hoven, Du Cange, Bartal, and Noltenius, cols. 440 f.).

dum ... exploderentur] The *dum* with the imperfect subjunctive in the sense of ‘while’ is mainly post-Classical. The usage is then analogous to that of *cum* (K.-St., II, pp. 377 f.).

papyraceas] While in ancient Latin *papyraceus* means ‘made of papyrus’, it among neo-Latin authors of course rather refers to ‘made of paper’ (cf. *DMLBS*; and Hoven). Noltenius’s explanation is very illustrative (col. 852): *Charta est materia linea expolita ad usum scribendi. Papyrus ... planta Aegyptiaca ... unde charta praeparabatur olim ... Hodie tamen chartam vulgo vocamus papyrum* (cf. Krebs & Schmalz, s.v. *papyrus*).

pulveris pyrij] For an extensive treatment of this new multiword coinage for ‘gunpowder’, first appearing in medieval Latin (Du Cange), as well as of its many synonymous expressions in neo-Latin, see Helander 2004, pp. 217 ff. In the dissertation *De pulvere pyrio* defended at Uppsala university in 1679 it is claimed, as Helander stresses, that *pulvis pyrius* is actually the most frequently occurring name for it.

per Digbaeum, de natura Corporum] Kenelm Digby (1603–1665), English courtier, diplomat and natural philosopher. Vallerius’s, or rather Morhof’s, reference is to Digby’s *Demonstratio Immortalitatis Animae Rationalis, sive Tractatus Duo Philosophici, in Quorum Priori Natura et Operationes Corporum ... explicantur* ... (1655), pp. 245 f.:

Consul Anglicanus ... aiebat calices vitreos domi suae supra abacum collocatos toto pugnae tempore ex tormentorum explosorum sono tremuisse, fenestras item papyraceas fissas fuisse, fracta quoque ova omnia quibus tunc temporis columbae incubabant.

And some sentences later:

Saepenumero etiam animadverti dum placido tranquilloque mari navigarem, concuti fenestras vitreas, in una navi ex tormentorum explosione in altera, millibus aliquot passuum adhuc distanti, ut visu detegi non potuerit. Memini me quondam simili occasione cursum mutasse, eumque direxisse sono, vel potius motu seu tremore ex sono impresso ... [p. 246] (Nondum enim quidquam audiebamus ...).

As we can see, the sentence *De muris fanis ... dissilientibus* is also lacking in Digby's original text, and could thus be an addition by Vallerius.

ex Scaligero, exercitatio 180] The reference is to Julius Caesar Scaliger's *Exotericarum exercitationum liber quintus decimus ...* (1557), *exercitatio* 180 (not 130 as there is in Morhof), the first section of which deals with the birth of mushrooms and truffles. Scaliger there states (p. 243):

Plinius non nive, sed imbris, et tonitruis, ait, Tuberum proventum esse uberiorem. Scilicet, opinor, illis materiam comparari: his terram quati, ac rariorem fieri superficiem.

Oldenburgium] i.e. Henry Oldenburg (1619–1677), German theologian, diplomat, natural philosopher, and secretary of the Royal Society of London. The reference most likely is, in spite of the incorrect page number, both in Morhof and in Vallerius, to the story related by Oldenburg in the *Acta philosophica Societatis Regiae in Anglia, anni M. DC. LXVII* (vol. II, 1672, p. 242):

Foemina *Raymund* de *Stow-Market*, quandocumque tonitru percipit, etsi e longinquo, corporis morbo afficitur. Debilitatur, stomachi infirmitate laborat, pronaque est in vomitum. In ipso momento (*at the very coming of it,*) incidit in perfectam *Choleram*, et perseverat in vomitu et profluvio ventris quoad tempestas durat, idque modo violentiore, quam soleat procurari medicamentis in hunc finem praescribi solitis. Et ita se habuit foemina illa a pueritia.

Psalmorum 29 versus 9] In the Vulgate, the verse in Psalm 28:9 is: *Vox Domini praeparantis cervos, et revelabit condensa; et in templo eius omnes dicent gloriam.* The voice of God is here generally understood as referring to thunder.

ex Plinio, libro 9 Cap. 38] Pliny the Elder's *Naturalis historia*, 9.108, has:

Si fulguret, comprimi conchas ac pro ieiunii modo minui. Si vero etiam tonuerit, pavidas ac repente compressas quae vocant physemata efficere, specie modo inani inflatas sine corpore, hos esse concharum abortus.

Alexandrum ab Alexandro] Alessandro Alessandri (1461–1523), Italian jurist. Vallerius had taken over the reference from Morhof, but as we saw above, Morhof had mentioned three works in order to attest to the story on how birds are frightened by military sound. Vallerius only writes *etc.* after

Alessandro Alessandri. However, in chapter seven of book four of Alessandri's *Genialium dierum libri sex* ... (1539) this very anecdote on the birds cannot be found. The heading of chapter is *Qui ordo in disponendis aciebus, et quae norma militiae apud Romanos olim servari solita fuerit, et quae apud exteros* (fol. 86v) and deals with military discipline in history, including the armies' making of great noise in order to frighten the enemy. Vallerius's unsuccessful reference *only* to Alessandri seemingly rules out the possibility that Vallerius had checked Morhof's sources himself.

Borellus] i.e. Giovanni Alfonso Borelli (1608–1679), Italian physiologist, physicist and professor of mathematics. The reference more precisely is to proposition 111 (both Morhof and Vallerius are wrong here) of his *De vi percussiois liber* (1667, p. 248). While Morhof made a literal quotation of the passage from Borelli (see above), Vallerius in his turn thus treated the section in Morhof more freely.

Cartesius] That is of course René Descartes (1596–1650), the well-known French mathematician, scientist and philosopher. The quotation is taken from part XII of chapter 7 of the section on *meteora* in the Latin translation of Descartes's grand work *Discours de la méthode*, which has the title *Specimina Philosophiae: seu Dissertatio de Methodo*. In the edition consulted here (the Elzevier of 1656), where the text agrees completely with Vallerius's version, the quoted part is to be found in page 209.

ne quidem] Writing the *ne quidem* without any word that separates them is unclassical. It is typical of the jurist authors of late antiquity (K.-St., II, p. 55), and the usage then becomes very common in neo-Latin, even in the greatest authors (Helander 2004, pp. 130 ff.).

Varenius in Geographia Generali libro 1 prop. 39] The quotation, which Vallerius has adjusted slightly in order to make it fit into the sentence, is taken from Bernhard Varen's abovementioned *Geographia Generalis*, more precisely book 1, section 5, chapter 19, proposition 39: *Sic invenietur altitudo nubis istius, quae nunquam deprehensa est excedere quadrantem milliaris* (Varen 1672, p. 248).

64. **objecta]** In Vallerius's text, we are close to our most common modern sense of the word (cf. *OED*, s.v. *object*, 1, a). Its origins are in scholastic theology, in the sense of 'something placed before or presented to the eyes or other senses' (*OED*), and it is thus first attested in medieval Latin (Blaise [2], *DMLBS*, s.v. *obicio*, 6). Both Krebs & Schmalz and Noltenius (cols. 634 f.) thus regard it as an unclassical philosophical *terminus technicus*.

perinde est] The *perinde* with a form of *esse* in the sense of 'it does not matter', is first attested in medieval Latin (cf. *LLNMA*). Krebs & Schmalz

thus state that the expression lacks all Classical authority, but that it is rather frequent in later Latin.

ita ut angulus reflexionis aequalis sit angulo incidentiae] In the section of book 9 of the *Musurgia* that treats echo, Kircher adduces this idea as the first among the *Axiomata et hypotheses* on the subject: ... *omnis angulus incidentiae est aequalis angulo reflexionis* (Kircher 1650, vol. II, p. 239), whereafter he also explains and demonstrates the truth of this sentence in a more elaborated way. In Vallerius's *Dissertatio optica de reflexione plani* (1698) this is even called a very universal law (p. 9): *Hujus reflexionis lex seu conditio haec est universalissima, quod angulus reflexionis aequalis sit angulo incidentiae*.

incidentiae] The word is late Latin as a technical term in rhetorics corresponding to the Greek περίστασις. (Blaise [1], *TLL*). In this context, however, we must certainly understand it closer to the stricter sense of *incido*, as 'to fall into'. This is how it was used in physics in the 17th century (*DMLBS*, s.v. *incidentia*, 1; *OED*, s.v. *incidence*, 4).

65. **plures Echo]** The Greek feminines ending in ῶ, like ῥηχώ, have no plural forms (Jannaris 1987, §410–411). The Latin genitive *echus* (ῥηχοῦς) and the accusative *echo* (ῥηχώ), are thus in accordance with the form in Classical ancient Greek. In neo-Latin *echo* was treated in various more- or less-fanciful ways, while in ancient Latin the word is only attested in the singular nominative *echo* and the singular accusatives *echo* and *echon* (*TLL*).

As can be seen, Vallerius here uses the form *echo* as a plural nominative, but such a form cannot be attested, neither in handbooks of the period, nor in modern lexica. For instance, Noltenius (col. 54) writes: *ECHO, -us, per unum C*, thus only stressing that the word should be spelled with one *c*. The same genitive form *echus* is given in L&S, Krebs & Schmalz, JPG, BFS, Matthiae, while *OLD* and *TLL* only account for the nominative and accusative singular (*echo* and *echo* or *echon*). In Kircher (1650, vol. II, p. 246) we find on the same page both the singular genitive form *echus*, the dative *echoni* and the accusative *echum*, as well as the plural nominative *echo* (*sunt Echo debiles et languidae*). Later on, however, we also meet the plural nominative *echi* in *Echi sursum et deorsum reverberantes* (Kircher 1650, vol. II, p. 250), as well as the genitive *Echonis* and the ablative *Echone* (p. 264). Vallerius himself, however, has the ablative *Echo* in thesis 67, and a genitive *Echo* in thesis 82 below.

una post aliam] See the comments on *unae post alteras* in thesis 20 above.

Gassendus in *Philosophia Epicuri*] The quotation is taken from the section in Pierre Gassendi's *Animadversiones in decimum librum Diogenis Laertii* that deals with sound and echo, and as in most other instances Vallerius has adjusted it in order to make it fit into the sentence more smoothly (1649, pp. 275 f.):

... pronunciata quippe in alterutro extremorum syllaba reddita est nobis decies septies quasi ex altero; et pronuntiata e medio, totiens ex utroque; cum et fuerit perhibitum quibusdam voce validiore redditam etiam vices sexies, priusquam evadens sensim extenuatior audiri prorsus desineret.

perhibitum fuisse] The shifted perfect passive again. See comments on *collapsum* ... *fuerit* in thesis 62 above.

Kircherus in sua *Musurgia*, lib. 9] Both quotations are taken from Kircher's *Musurgia universalis*, book 9, (1650, vol. 2, p. 290), from a passage where Kircher explains the wonderful echo that can be heard in the Villa Simonetta in Milan. The quotations are literal, with the exception that the word *propagari* has been supplied from a previous clause in the same discussion. The second quotation refers specifically to the echo of the Villa Simonetta.

aedes lapideas sibi invicem in foro majori hic Upsaliae oppositas] The stone houses on the great square of Uppsala were built just some decades before Vallerius's dissertation (on which see Herdin 1932, pp. 119 ff.). These buildings, belonging to rich local burghers, are also all visible on a wood-cut from Olaus Rudbeck's magnificent *Atlantica* (1679–1702), contemporary with Vallerius. As can be seen, they rise high above the other more simple houses (the picture below has been taken from Harnesk & Oscarsson 1986, p. 56).



integram sententiam pronunciare] The idea certainly recurs in other treatments of echo of the time. In book three of Mersenne's *Harmonie universelle*, however, the author more specifically rejects the idea that an echo from a tower at the Aventine hill in Rome could render the whole first verse of the Aeneid eight times (cf. Hunt 1978, pp. 96 f.).

66. **Parabolicae]** The word *parabola* (from the Greek παραβολή, ‘comparison’) was in mathematics first used by Apollonius of Perga (Solvang, s.v. *parabel*). Micraelius (1661, col. 962) simply explains it as a *conica sectio*. Also *parabolicus* seems to be first attested in the 17th century (cf. Latham) in this geometrical sense, while as a form it is late Latin (*TLL*, Souter), then in the sense of ‘allegorical’.

utpote in quibus] In causal relative clauses of this kind the subjunctive occurs most often in Classical Latin, but here, and in *De modis*, CXVI, the indicative is used (cf. Östlund 2000, pp. 46 f.).

maximae diametro figurae] Notice here that there is of course only one diameter that is greatest in an ellipse, while in a circular figure all diameters are necessarily equally great, and in the parabola the axis is usually considered as the diameter.

quod habet Kircherus] The reference, which concerns the whole of thesis 66, is to Kircher’s *Musurgia universalis*, book 9 (1650, vol. 2, pp. 250 ff.), a chapter that expounds the principles on how echo functions. The quotation has been taken from a heading on p. 266, in a passage where different problems connected to echo are dealt with: *Chorum aliquius Ecclesiae construere eo artificio, ut tres Cantores tantum praestent, quantum centum* (‘to build a sanctuary of a church with such artfulness, that three singers bring about as much as a hundred’).

67. **a Mersenno observatum ... ex Cartesii Epistula 92, part. 2]** The reference is to Descartes’s letter to Mersenne, contained as no. 92 in the *Epistolae ... pars secunda* (1668, pp. 288 ff.). In the third section of the letter, Descartes comments upon earlier information given by Mersenne, saying that ‘he cannot conjecture anything else about the echo that Mersenne claims rather renders two sounds at the distance of a sixth from each other than other sounds, but that the body from which it is reflected should consist of diverse parts, several of which concord with one of these tones, but others with the other one’ (p. 288):

Nihil aliud conjectare possum de echo illa, quam dicis melius reddere duos sonos sexta differentes, quam quoslibet alios, nisi quod corpus a quo reflectitur debeat constare ex diversis partibus, quarum nonnullae cum horum tonorum uno, aliae vero cum altero conveniant.

68. **longitudine soni]** Vallerius defines this term himself here as ‘duration’, although in other words, viz. *tempus ... quo eum juxta certam mensuram metimur*. This sense is also attested in other earlier and contemporary material, as in *DMLBS*, s.v. *longitudo*, 6, d; Walther, s.v. *longitudo soni*, and in Lippius 1612, fol. B5r. In Bellman / Vallerius (1706, p. 2) we later meet the description as time, which is called *tactus* by musicians (*longitudo soni tempus ejus est, Musicis tactus nomine veniens*).

mensuram] *Mensura* is also a technical term in music, in different senses.

Vallerius here regards it as the ‘measure according to which we estimate musical time’ (cf. *DMLBS*, s.v. *mensura*, 2, f). It is thus almost equivalent to *tactus*. Cf. Praetorius (1619, vol. 3, p. 48): *De tactu, seu notarum mensura; (Italis battuta) et signis*; Kircher (1650, vol. 2, p. 52): *Itali vocant la battuta, Boetius plausum, alij tactum et mensuram*; and Walther: *der Tact, oder vielmehr die Ausmessung der Noten und Pausen*.

tactus] The *tactus* will of course be treated at length in the dissertation *De tactu* below. However, as a musical *terminus technicus* for a unit of time (‘beat’) measured by a movement of the hand, it first appears in medieval Latin (*GMO*, cf. Latham, and Bartal, s.v. *tactus musici*; see further Houle 1987, pp. 1 ff.). Walther (s.v. *tact*) likewise says that it refers to *die Abmessung der Zeit, und Music-Noten* (cf. *HMT*, s.v. *tactus*, IV), and he explains it etymologically as without doubt being derived from *tangendo, vom Berühren*, since such measures in antiquity were expressed with the feet ‘touching’ the ground. For several other versions of the word’s origins, see *HMT*, s.v. *tactus*, I; and *MGG*, vol. 8, cols. 259 f.

Quia vero sensus nostri ... fit progressio] The passage is close to a section in Descartes’s *Musicae compendium*. A little earlier on the same page Descartes stated that the sense can perceive those things more easily in which there is less difference between the parts (*Illud objectum facilius sensu percipitur, in quo minor est differentia partium*), and that parts that differ less are in a greater proportion to each other (*Partes totius objecti minus inter se differentes esse dicimus, inter quas est major proportio*). Then he applies this to musical time, and begins his chapter on the subject thus (1978, p. 4):

Tempus in sonis debet constare aequalibus partibus; quia illae sunt quae omnium facillime sensu percipiuntur, ex 4^o praenotato, vel partibus quae sint in proportionem dupla vel tripla, nec ulterius fit progressio, quia hae facillime omnium auditu distinguuntur ...

in illis instrumentis ... maioremque temporis varietatem admittere] Cf. again from the chapter on time in Descartes, where the same aspects of the percussion instruments are stressed, in which measure alone is perceived. There one can continue beyond the duple or triple proportion (1978, p. 8):

Ut patet in tympano instrumento bellico, in quo nihil aliud spectatur quam mensura, quae ideo opinor ibi esse potest non solum duabus vel tribus partibus constans, sed etiam forte quinque aut septem aliisque. Cum enim in tali instrumento sensus nihil aliud habeat advertendum quam tempus, idcirco in tempore potest esse major diversitas ut magis sensum occupet.

Quamvis enim notulae ... sed ex primis multiplicati] Here too Vallerius follows Descartes closely, where the latter brings figurate music into the discussion, likewise stating that this does not change the proportion (1978, pp. 6 and 62):

Sed dices, possunt 4^{or} notas contra unam ponere vel 8, ergo ulterius etiam ad hos numeros debemus progredi, sed respondeo hos numeros non esse primos inter se, ideoque novas proportiones non generare, sed tantum multiplicare duplicem ...

Musica diminuta] The concept is almost equivalent to florid and figurate music, although the latter admittedly also includes augmentation. Cf. Walther, s.v. *diminutione*, but also Descartes's *Musicae compendium* (1978, pp. 6 and 62). The latter instance says that 'diminution is when two, four or more notes in another part are placed against one note of a part': *Diminutio est cum contra unam notam unius partis 2^{ae} vel 4^{or} vel plures in alia parte ponuntur* (cf. *LML*, s.v. *diminutio*, III; *GMO*, s.v. *diminution*; *MGG*, vol. 4, cols. 558 ff.; and Kircher 1650, vol. 1., p. 216). While *diminutio* in this sense is attested in medieval Latin (*LML*), *diminutus* seems not to be so. When treating counterpoint, Kircher explains the *contrapunctus floridus seu fractus*, the both adjectives being equivalent to *diminutus*. It is called *fractus* ('broken'), 'since the notes of the remaining parts, which are applied to the choral singing resolved into figures of minor notes, are virtually broken and shattered into small pieces' (1650, vol. 1, p. 242, cf. pp. 301 ff.):

... quod reliquarum vocum notae, quae ad choralem cantum applicantur in minores notarum figuras resolutae, quasi in minutias frangantur et comminuantur ...

primi] Sc. *numeri*. The concept of primes is first found in Aristotle. The Latin designation *numerus primus*, however, is first attested in late Latin, in authors as Martianus Capella, Boethius and Cassiodorus (Tropfke vol. 1, p. 96). Micraelius (1661, col. 898) explains it as: *quem sola unitas metitur, ut 1. 3. 5. 7*, i.e. it is divisible only by itself and 1.

tripulae] The word *tripula* (sc. *proportio*) is a technical term in music theory in itself as well, occurring in Boethius, although the adjective *tripulus* itself, from the Greek τριπλούς, can be found as early as Cicero (Forcellini, s.v. *tripulus*). In Walther (s.v. *tripola*) it is explained as:

... bedeutet einen aus dreyen membris von einerley Geltung bestehenden Tripel i.e. ungeraden Tact, davon die 2 ersten im Niederschlagen, und das 3te im Aufheben der Hand tractirt werden.

Musici Practici] In music discourse, the separation in theoretical and practical is found as early as antiquity. In Cleonides's (perh. 2nd century AD) musical manual *Εἰσαγωγή ἁρμονική* ('musical introduction'), which for a long time was attributed to Euclid (e.g. in the edition of Meibom in 1652), even the definition of music in the very first sentence makes the distinction: Ἀρμονική ἐστὶν ἐπιστήμη θεωρητικὴ τε καὶ πρακτικὴ τῆς τοῦ ἡρμωσμένου φύσεως ('Music is the science of contemplating and practising the nature of the harmonious'). Cleonides's definition was also a stock-ingredient in music primers contemporary with Vallerius (cf. e.g. Schott 1677, p. 515, and Orostander's in Lundberg & Sjökvist 2010, pp. 68 ff. and 93 f.).

sesquialtera] Sc. *proportio*. The concept, which is first attested in a musical context in Augustine, although it previously also occurs in Cicero and Vitruvius (Forcellini, s.v. *sesquialter*) is explained by Walther (s.v. *proportio sesquialtera*) as: *wenn z. E. eine grössere Zahl die kleinere ein und ein halbmahl in sich fasset; als 3-2. 6-4. 9-6.*

nullus unquam numerus triplae possit praeponi ...] This last section of the thesis refers to the numbers written out as fractions at the very beginning of the staff, serving as a sign for trochaic *tactus* in contemporary music. The matter is dealt with much more extensively in theses 13–15 of the dissertation *De Tactu* below. A briefer and more elementary treatment reflecting Vallerius's views can for example be found in the chapter on *tactus* (no. 4) in Orostander's music primer from 1703 (Lundberg & Sjökvist 2010, pp. 72 ff.).

69. **teste Kirchero]** Kircher in many places deals with the great power and the capacity of music for affecting living beings, be they children, the ignorant, or even animals, but especially in book 9 of the *Musurgia* (1650). See e.g. vol. 2, pp. 201 ff. and 211 f. (see also Palisca 2006, pp. 194 f., where Kircher's view on the affects is shortly summarized). It is worth noticing that Vallerius stresses the importance of the *tactus* for this power much more than Kircher does. This circumstance that even wild animals dance along with rhythm is also mentioned both in *De modis* (103) and *De tactu* (18) below, and in Bellman / Vallerius (1706, p. 84).

unde oritur illa titillatio] Cf. Kircher 1650, vol. 2, p. 204: *hinc fit ut dum optime constitutam harmoniam ac suavissimam percipimus melodiam, titillationem quandam in chorde animoque ... sentire videamur.*

Concentus] As a technical term in music, *concentus* is used in several ways. While its general sense is 'musical sound' or 'harmony', it was with time often narrowed to 'simultaneous and distinct musical sound', or even 'a chord', 'a composition', 'an example', or 'the highest part', and some more (*LML*, *GMO*). Noltenius (col. 1692), accordingly, rejects phrases like *concentum canere* and *partibus canere* as bad Latin, and prefers *symphonia canere*, with a reference to Cicero. Cf. Walther, where *concen-*

tus is explained as *ein Accord*, but also as the name of certain intervals. Adams, however, simply translates it as ‘concert’, ‘concord’. In the present context, we should understand it almost in a concrete sense, such as ‘consort’, in the sense of ‘a company of musicians playing together’ (*OED*, s.v. *consort*, n², 4; cf. *HMT*, s.v. *consort*, I; *MGG*, vol. 5, cols. 628 ff.; and *OLD*, s.v. *concentus*, 1). As it seems, this sense is intended when Vallerius writes *concentus musicus* (cf. thesis 77 below, but not in Retzelius’s *De tactu*, 7 and 21).

70. **Regal]** i.e. a ‘kind of small organ in which the sound is produced by one or more sets of beating reeds provided with little or almost no resonators’ (*GMO*, s.v. *regals*; cf. Vallerius / Bergrot 1717, p. 21; Hülphers 1969[1773], p. 84; Walther, s.v. *regale*, 3; and Praetorius 1619, II, pp. 72 ff.). The name, which is the same in English (cf. *OED*, s.v. *regal*, n³, as well as Adams), is probably derived from *rigole*, from medieval Latin *rigus*, *rigulus* (*MGG*, vol. 7, col. 1013). Swedberg explains the word simply as *spel*, *organum musicum*.

in initio tactuum ubi puncta ut plurimum occurrunt] Cf. again Descartes’s *Musicae compendium*, where the author states that musicians and singers naturally stress the first beat of the *tactus*, especially in music to which people dance (1978, p. 6):

Quod dico fieri tantum quidam spiritus intensione in vocali Musica, vel tactus in instrumentis, ita ut initio cujusque battutae distinctius sonus emittatur, quod naturaliter observant cantores et qui ludunt instrumentis, praecipue in cantilenis ad quarum numeros solemus saltare et tripudiare

puncta] As regards the many different senses of *punctum* / *punctus* in music history, see *HMT*, s.v. *punctus*. For the present context, however, where Vallerius stresses the connection between *punctum* and emphasis, much in accordance with our modern usage, cf. e.g. Burmeister’s definition, where it is a very small mark that is attached to a note, so that its value is increased by a half (1993[1606], p. 38): *Punctum est minutus apex ... qui notae apponitur, ut valorem ejus ad dimidium augeat*. See also *GMO*, s.v. *dotted rhythms*. Typical dances of the time, in which the first notes of the *tactus* are often dotted, are e.g. the *gigue* and the *courante*.

fundamentum seu Bassum generalem] As regards these almost equivalent terms, cf. Walther (s.v. *fundamento*), who explains the first as: *jede Partie, so den Bass führet; insonderheit aber der General-Bass, weil dieser, nebst den Grund-Noten, auch die Harmonie zugleich mitexprimiret*. Burmeister (1993[1606], p. 42) likewise says that the bass is called *fundamentum*, since it is the base of the entire harmony: *Bassus (... fundamentum dicitur, quod totius harmoniae sit fulcrum)*. And in Bellman / Vallerius (1706, pp. 42 f.) we read: ... *quod Bassus primo*,

tanquam fundamentum, construatur. For an overview of the history of the *Generalbass* concept, see *MGG*, vol. 3, cols. 1194 ff.; *GMO*, s.v. *Generalbass*, as well as *GMO*, s.v. *fundament instrument*, a concept used by Praetorius.

proportionem triplam ... in chorearum saltu secundo] Refined and simple people's different usages of the triple proportion are treated more extensively in thesis 12 of the dissertation *De tactu* below.

71. The part of the dissertation on consonances and dissonances that starts here corresponds to books four and five of Mersenne's *Harmonicorum libri XII*. To begin with, the simple consonances are all dealt with there, and finally summarized in a table in proposition 13 (1648, p. 56). There is, however, also a section dealing with the origin of consonances in strings in Kircher's *Musurgia* (1650, vol. 1, pp. 430 ff.).

Consonantias et Dissonantias] Here and in the following, we are aided by such general definitions as they are presented in Bellman / Vallerius (1706, p. 17), in the tradition of Boethius, where consonance is described as a proportion or concord of mutually different sounds, i.e. low and high ones, that have been made into one (*est autem consonantia dissimilium inter se, h. e. gravium acutorumque, sonorum in unum redacta proportio seu concordia*), and dissonance as that which offends the ears by nature (*dissonantia, quae aures naturaliter offendunt*). Definitions with slightly different nuances can be found in Burmeister, for instance, who explains consonance as either a concord of voices that differ in relation to each other, or a mixture of high and low sounds, or a quality that comes about from a collision of two sounds, which affects the ears with sweetness. As can be seen, Burmeister himself preferred the third definition (Burmeister 1993[1606], p. 50):

Consonantia (quae et concordantia, concentus vel harmonia dicitur) est (ut Boëtius libro 1, capitibus 3 et 8, definit) dissimilium inter se vocum in unam redacta concordia, vel, Consonantia est acuti gravisque soni mixtura, auribus suaviter uniformiterque accidens, vel (ut nos eam definire conati sumus), Consonantia est qualitas ex collisione duorum sonorum orta, aures suaviter afficiens.

Burmeister likewise defines dissonance as two mixed sounds that strike the ears unpleasantly (Burmeister 1993[1606], p. 54):

Dissonantia (quae et Discordantia et diaphonia nominatur) est duorum sonorum sibi permixtorum ad aures veniens aspera atque injucunda percussio.

For a general overview of the concepts of consonance and dissonance, see *MGG*, vol. 5, cols. 565 ff. In thesis 92 of *De modis* below, Vallerius

presents a much extended table of consonances and their proportions. As regards Vincenzo Galilei's (the father of Galileo) refutation of these traditional intervals of consonances as being 'bound up with the physical cause of these intervals', see Palisca 1961, pp. 127 ff. and Cohen 1984, pp. 82 f.

Consonantias ... compositas] The multiword term is explained by Walther (s.v. *Consonantiae compositae*) as: *diejenigen Consonanzen, so die Octav überschreiten*. Cf. LML, s.v. *consonantia simplex*, and Adams, s.v. *Compound Harmony*.

simplicibus] Sc. *consonantiis*. Cf. likewise Walther (s.v. *Consonantiae simplices*), where it says: *diejenigen Consonanzen, welche die Octav nicht überschreiten, sondern in selbiger enthalten sind*. Cf. Mersenne 1648, p. 56; LML, s.v. *consonantia simplex*; and Adams, s.v. *simple harmony*.

As regards both these terms on consonances, cf. Descartes's words in *Compendium musicae*. He declares that there are three species of consonance: the simple one, the one that is a compound of the simple and the octave, and the one that is a compound of the simple and two octaves (1978, p. 14):

... sequitur cujuscunque generis consonantiarum tres esse species, nempe una est simplex, alia composita a simplici et octava, 3^a composita a simplici et duabus octavis.

72. **Cum ... vibrationes ... exacte conveniunt, faciunt in nobis concentum]**

Known in modern research as the *coincidence theory*, this notion of consonance, on which Vallerius bases his discussion in the following, was embraced by most scholars dealing with music theory in the 17th century. Consonance is created when the vibrations of the different sounds coincide, even if they are of different frequency. The more often the vibrations coincide, the more harmonious is the interval (Gouk 2002, p. 236; see also Palisca 1961, pp. 104 ff.; Cohen 1984, pp. 32, 90 ff. and 206 ff.). Cohen even claims that this theory, and the questions and experiments it brought about, actually 'became the origin of the science of acoustics' (p. 96).

Mersenne treats the matter in proposition 22 ff. of book four of his *Harmonicorum libri XII*, and introduces it by stating that there is a general principle why one consonance is more pleasant than another, viz. the more frequent union of the beats or recurrences by which the sounds are produced (1648, pp. 62 ff.):

Est autem alia ratio generalis cur una consonantia sit alia gratior, quae sumitur ex frequentiori unione ictuum, vel recursuum, quibus soni producuntur.

In Mersenne's correspondance with Descartes, however, the latter continuously stressed the difference between sweetness and concordance on the one hand, and pleasingness on the other, claiming that these are not at all the same. Mersenne eventually accepted this distinction as well (Palisca 1961, pp. 110 ff.).

73. *quarum omnium nec proportio nec numerus exprimi potest*

Mersenne, however, claims that almost all dissonances can be found by dividing a string in two, and at the same time presents a table of all dissonances occurring in the diatonic scale, expressed in root numbers (Mersenne 1648, pp. 74 f.).

74. *quaenam ex Consonantiis ... perfectae ac simplices sint* The perfect consonance (cf. *LML*, s.v. *consonantia perfecta*), which Vallerius also calls *simplex* in a different sense from the abovementioned, as we can see in his own text, is defined by Burmeister as the consonance to which you cannot add nor take away even a comma. Its kinds are the diapente and the diapason, both the simple and the compound, which is the disdiapason (Burmeister 1993[1606], p. 50):

Perfecta consonantia est, cui ne comma, nedum semitonium addas vel detrahas. Species ejus sunt diapente, hoc est Quinta, et Diapason, sive simplex vel composita, quae est, disdiapason.

duodecimam quinta esse perfectiorem et simpliciore The same explanation, using a very similar illustration, is given by Mersenne in proposition 24 of book four of *Harmonicorum libri XII* (1648, pp. 63 f.).

75. *melodia* The word is late Latin (Blaise [1]; *TLL*; and *HMT*, s.v. *melodia*, I), and Krebs & Schmalz accordingly reject it. Walther explains it as a *Sang-Weise* and a 'continuous connexion of sounds' (*continuata sonorum connectio*). In Burmeister it is more specifically defined as a period of sounds following upon each other according to certain intervals that are made into a euphony which stirs the affects of men (Burmeister 1993[1606], p. 56):

... pro intervallorum ratione sonorum se invicem subsequentium affectio, ad modulamen, affectus in homine non plane amuso creans, parata, vel facta.

For an overview of the development of the concept, see *MGG*, vol. 6, cols. 35 ff.

modo Musico The musical modes are the subject of the next dissertation written by Vallerius in 1686, and will be treated much more extensively below. Here it is therefore enough only to quote the first wide definition

in Walther (s.v. *Modus Musicus*): *ist die Art einen Gesang anzufangen, in gewissen Grenzen recht fortzuführen, und gebührend zu endigen.*

Cartesius in Epistula quadam ad Mersennum] The reference most likely is to Descartes's letter to Mersenne which in the *Epistolae ... secunda pars* is no. 76 (1668, pp. 248 ff.). Descartes there also stresses the importance of small proportions in music, by relating how his late patron could not sustain listening to music, in which the difference between the major and the minor semitone was not observed, once he had learned to differentiate between them (p. 249):

Imo si D.N. esset adhuc in vivis, testari posset sensibilem admodum differentiam esse inter semitonos majorem et minorem. Postquam enim id semel jussissem illum observare, dicebat se non posse ferre concentus, in quibus ea non esset observata.

As can be seen, not exactly the same thing is said here as in Vallerius's text. While, for instance, Descartes speaks about 'semitones', Vallerius says 'tones'. And the sentence that in Vallerius was printed in italics is therefore not a proper quotation, but merely a paraphrase of Descartes.

tertia major et minor] In the passage we see that Vallerius recognizes the major and minor third as the difference between merry and sad melodies, and that this circumstance is obvious to all. Descartes in his *Musicae compendium* states the same, but also includes the difference between the major and minor sixth (1978, p. 28): *ditonus et sexta major gratiores laetioresque sunt quam tertia et sexta minores, ut etiam a practicis fuit observatum*. In thesis 105 of *De modis* below, Vallerius also uses the terms *durus* and *mollis* when the same matter is treated, and in Bellman / Vallerius (1706, p. 33) it is even said that a song is *durus* or *mollis* depending on the position of the major and minor thirds and sixths (*Cantus vero ipsemet Durus vel Mollis fieri potest ... differentiae ratio petenda est ex Tertiae Majoris et Minoris, sextaeque duplicis, collocatione*). In Orostander's manual of 1703, the new concepts were then also spread to beginners (Lundberg and Sjökvist 2010, pp. 74 ff.). As we know, this distinction between the major and the minor third would eventually result in the only two modes of today, the major and the minor (cf. Palisca 2006, pp. 95 ff.).

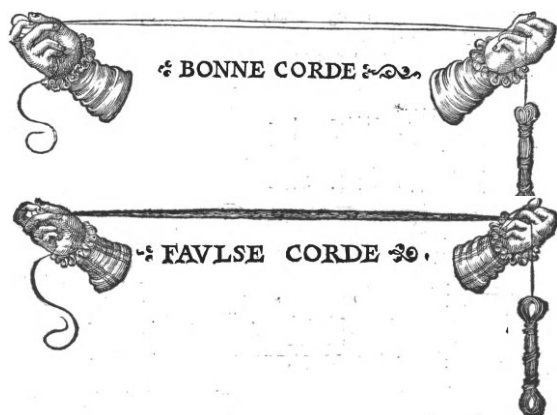
76. In this thesis Vallerius apparently differs from Mersenne. The latter in his *Harmonicorum libri XII*, for instance, states that that the octave is the sweetest consonance, since it is easy to grasp its motions, and its terms are simpler in comparison to other consonances (1648, p. 52, cf. pp. 60 ff.): *Ratio vero cur Octava sit omnium gratissima, sumitur ex faciliiori motuum, a quibus fit comprehensione, maioriq[ue] terminorum simplicitate* (cf. Cohen 1984, pp. 100 f.).

For Vallerius human judgment is thus given greater importance for estimating sweetness. The discussion is, moreover, rather similar to Descartes's proposition in a letter to Mersenne in 1631, in which it is suggested that concordance and pleasingness not necessarily go well together. The latter namely depends greatly on the circumstances. In sad compositions, for instance, the minor third is much more pleasing than the major. One can say, however, that 'the fourth is more concordant than the major third, even though ordinarily it is not more pleasing, in the same way that senna is sweeter than olives, but not more pleasing to our taste' (quotation and translation from Palisca 2006, p. 155):

... en sorte qu'on peut dire absolument que la quarte est plus accordante que la tierce majeure, encore la casse est bien plus douce que les olives, mais non pas si agreable à nostre goust.

78. **partium inaequalitas in nervo**] Descartes had in his letters to Mersenne in 1633 explained the production of the overtones in a similar way. These were caused by a certain inequality in the string that produced them, so that one regular stroke also brought about several smaller ones (see Cohen 1984, pp. 166 f.). Isaac Beeckman suggested likewise the same year, viz. that an uneven string 'caused the particles of air around it to vibrate at different rates' (Palisca 1961, p. 98).

nervus mediocriter inter manus tensus digito pulsetur] The method for separating between good and bad strings is further described by Mersenne, and there illustrated with the pictures shown below. By holding a string between the hands and striking it, the irregularities of the string can be seen and heard as well as felt (Mersenne 1648, pp. [ii]24 f.).



Quod Practicis notissimum est in nervis eligendis] This sentence, and thus also the entire preceding discussion, is typical of the science of music (and science quite generally) of the time, where phenomena that had been known for a long time to practitioners were now subjected to scientific dis-

cussion and investigation (cf. Cohen 1984, p. 248; and Palisca 1961, p. 100).

80. **chordam unam pulsatam etiam aliam ... ad sonum impellere**] The phenomenon treated in the following, the sympathetic vibration of unison strings, i.e. the sounding of one string may cause another string tuned at the same pitch to produce its own sound at the same pitch, was known in antiquity, but was first explained by Girolamo Fracastoro in 1546 (Palisca 1961, p. 97; Cohen 1984, p. 30; cf. Gouk 1991, pp. 98 ff.; and Wardhough 2008, pp. 113 ff.). Fracastoro's discussion was later referred to by Mersenne (1648, pp. 65 ff.).

violis majoribus] In thesis 112 of *De modis* we read *vulgo Baassviol* after the name of this instrument. Notably there is some confusion in the usage of names of different bowed string instruments at this time. Walther, for instance, explains the French *Basse de Viole* as *eine kleine Bass-Geige; Violadigamba*, (cf. *GMO*, s.v. *viola da gamba*; and *MGG*, vol. 9, cols. 1572 ff.). We should, however, in accordance with the commentary on thesis 26 above, understand the multiword term here in a wider sense, as the 'lowest instrument of the viol- or violin-family'.

campanisterio] The word is very unusual, and could not be attested in any dictionaries investigated, neither modern nor contemporary with Vallerius. It can be found in other texts though. One is the *Flora Upsaliensis* by Georg Wahlenberg from 1820. There we read (p. 412): *in tectis ligneis campanisteriorum ad templa rusticorum ex. gr. Upsaliae antiquae*. The same author also uses the word in the same sense at other instances, as in the *Flora Suecica* (vol. II, 1826), p. 826. However, both Swedberg and Sahlstedt (s.v. *klockstapel*) give *campanarium* as the Latin word for bell-tower.

manuchordium] From Vallerius's description, we see that he refers to an instrument with several strings, and not to the single-stringed monochord, outdated by this time. He also separates between *manuchordium* and *clavichordium*, as we can see from the following sentence. In Adams, the clavichordium is explained as a 'spinet', and the manichord simply as an instrument that resembles the spinet somewhat. The latter instrument is also fully described in Mersenne (1648, pp. [ii]63 ff.). We should be careful here, though, since the terminology is not clear, and the names refer to different instruments in different countries at different periods, while also remembering Praetorius's words that the *clavichordium* was invented from the single-stringed *monochordum*, and that the *clavichordium* was *das Fundament aller Clavirten Instrumenten* (Praetorius 1619, II, pp. 60 f., cf. e.g. *LLNMA*, s.v. *clavichordium*; Hoven, s.v. *clavicordium*; Hülphers 1969[1773], p. 79; *OED*, s.v. *spinet*, *clavichord*, *manichord*, and *monochord*, A, 2, a; Walther, s.v. *manicordion*, which simply refers to *clavichordium*; *GMO*, s.v. *Clavichord*, and *spinet*; and *MGG*, vol. 2,

cols. 901 ff.). The form *manu*chordium does not seem common, but it can for example also be found in the title of Johann Nanning's (Spiridio a Monte Carmelo) *Nova instructio pro pulsandis organis, spinettis, manu-chordiis* (vol. I, 1669), as well as in Kircher's *Musurgia* (1650, vol. 1, pp. 452 f.).

clavechordii] See the commentary above. The spelling *clave*chordium is very rare, but attested for example in a building-contract from Belgium in 1621, in which the description of the instrument actually also fits a harpsichord or virginal better than a clavichord (Ripin 1970, p. 48).

81. **ut ex Kirchero in *Musurgia* l. 9, c. 7]** Vallerius's quotation is almost completely literal, all the way from *contigit subinde* to *perpetuo mobilis*, from Kircher's *Musurgia*, book 9 (1650, vol. 2, p. 226), from a section that deals with the power of music for exciting different kinds of bodies. Vallerius has thus also taken over the reference made to Mersenne, which I have not been able to attest in his own works, directly from Kircher at this instance. The use of regular type makes it look like Vallerius's own reference, but in reality this here only indicates that he has altered word order somewhat.

ex Mersenno] As a matter of fact, this very section attributed to Mersenne was also later referred to in several other treatises on the effects of sound. We can, for instance, find it in Gaspar Schott's *Magiae universalis naturae et artis, pars II* (1674 [first ed. of the work in 1657–1659]), p. 183:

Et Mersennus refert in sua Harmonia: Parisiis in templo Franciscanorum, dum Organa pulsantur, pavimentum templi circa diametri finem, quae ex quadrato nascitur, cujus organa latus sunt, ita concuti, ut fermè verearis ne terra dehiscat; quod tamen minimè sentitur si vel propius ad organa accedas vel ab eis longius recedas.

With exactly this wording, the section was later related in Otto von Guericke's *Experimenta Nova ... de Vacuo Spatio* (1672), p. 138.

It also occurs, somewhat adjusted, in the second enlarged edition of Morhof's *Epistola De Scypho Vitreo ...* (1682). For there we read (p. 171):

Item e Mersenno apud PP. Franciscanus [sic] Parisienses, dum organa pulsantur, pavimentum circa diametri finem, quae ex quadrato nascitur, cujus organa latus sint, ita concuti, ut ferme verearis, ne terra dehiscat, quod tamen minime sentias, si vel propius ad organa accedas, vel ab iis longius recedas.

apud Franciscanos Parisienses] Mersenne himself was a Minim friar and lived in Paris between 1619 and 1648, but also during some periods pre-

vious to that. *Franciscanus* is of course a word coined in the Middle Ages (cf. Blaise [2]).

ne terra dehiscat] The expression is proverbial, the origin being Dido's words in Verg. *Aen.* 4.24 *sed mihi vel tellus optem prius ima dehiscat*. It was later also treated in Erasmus's very influential *Adagia* (1559, p. 649).

catadupas Tyburtinas] In Classical Latin *Catadupa* (n. pl.), from the Greek κατάδουπα, can be found in Cicero about the Cataracts of the Nile, and *Catadupi* (m. pl.) twice in Pliny the Elder about the people living close to them. In the quotation from Mersenne, however, *catadupa* is treated as a feminine word, and this finds support in some, but not all, handbooks of the time: e.g. BFS says it is a feminine, while Matthiae says it is neutral.

The waterfalls of the Aniene river at Tibur near Rom (the modern Tivoli) go down the Western slope of the Sabine hills, and fall from a height of more than 350 feet.

Item ex Epistula Marhofij de scypho vitreo ...] The first quotation is taken from the first edition (Morhof 1672), and can be found on fol. A2v. One change was made by Vallerius. The *ejus* of the original was altered to *vitri*, for the sake of clarity. That is also why *vitri* was not printed in italics in Vallerius's dissertation.

The second quotation (after *praeterea*) can be found in Morhof 1672, fols. D3v f. It is rendered literally, with the exception for a sentence that has been omitted between *non fiebat* and *Sensi*. This sentence reads: *Quod profecto nullam aliam ob causam, quam aequalitatem vocis, cum sono ligni evenire potuit.*

Pandurae] The pandoura (from the Greek πανδοῦρα), which according to Isidore of Sevilla (*orig.* 3.20) had been invented by Pan, is in antiquity mostly considered to have been a kind of lute with fewer strings than the kithara (*GMO*, s.v. *pandoura*; and *MGG*, vol. 5, cols. 964 ff.). In Vallerius's time, however, the pandoura is described either like Bonanni as a (Walther, s.v. *pandura*):

... bey den Neapolitanern also genanntes, und mit 8 Metallenen Saiten bezogenes Instrument, so mit ein Feder-Kiel tractirt wird.

or like Praetorius as (1619, II, pp. 53 f.):

... in Engelland erfunden, nach der Lauten Art, fast einer Grossen Cyther gleich, mit einfältigen und doppelt- auch vier-oder mehrfach gedrehten Messings und stälenen Säiten bezogen ...

There is also a description and a picture of it in Mersenne (1648, pp. [ii]25), where it is stated that the peculiarity of this instrument in the lute family is its shape, since its soundtable is round.

82. **diësi]** The word, from the Greek διέσις (from διήμι, ‘dismiss’) in antiquity either refers to a semitone (the Pythagoreans), or a quarter tone (Aristoxenus, Aristides, Quintilian). It is explained in Classical Latin (in Vitr. 5.4.3): *diheis autem est toni pars quarta*, and a view of the concept similar to this later one generally prevailed also at the time of Vallerius (cf. *GMO*, s.v. *diesis* [ii], *MGG*, vol. 4, col. 1075; Kircher 1650, vol. 1, p. 102; Bellman / Vallerius 1706, p. 24; and Walther, s.v. διέσις [sic]. The proportion of the diesis is 128 to 125 (Lippius 1612, fol. B8v).

83. **apud Kircherum in Musurgia]** Kircher relates how music can heal people bitten by a tarantula primarily in *Musurgia*, book 9 (1650, vol. 2, pp. 218 ff.), in a part of the work that deals with cases in which the magical and medical powers of music can be detected.

magnetismo] The word is a neo-Latin neologism, first being attested in the 17th century (Latham), and as we can see from this occurrence, its reference was much wider than what we are used to today. In Zedler it is, among other things, claimed that some philosophers describe magnetism as ‘all influences of nature that contain anything hidden’ and that it is ‘a hidden property of certain bodies, the power of which has certain strange effects (Zedler, s.v. *magnetismus*, cf. *OED*, s.v. *magnetism*, 1, b [first attested 1616]). Cf. Kircher 1650, vol. 2, p. 201: *quantus insit musicis modulis Magnetismus ... nemo nescit*.

ex Tarantulae morsu] The name *tarantula*, which is attested in medieval Latin (Du Cange) is taken from the Italian town of Taranto, and at this time usually referred to the wolf spider (cf. Zedler, s.v. *tarantel*). A bite of it allegedly caused tarantism, a disease that made the bitten man dance wildly (the tarantella). The disease could only be healed with the aid of music, and this fact was so well established at this time (Marsilio Ficino and Heinrich Cornelius Agrippa were the first to mention it), that it is sometimes related even in general dictionaries (see Matthiae, s.v. *tarantula*). As Vallerius says, Kircher treats the matter in his *Musurgia*, and had already done so in his *Magnes, sive de arte magnetica* of 1641, but many other authors do as well (cf. Gouk 1999, p. 178, with further references). In 1702 the son Georg Vallerius, under Harald’s own presidency, also defended a dissertation in Uppsala dealing with this spider, the *Exercitium philosophicum de tarantula ...* (the dissertation is available in Italian translation in *La tarantola Iperborea*, ed. Gino L. Di Mitri, 1998).

de captura piscis Psychiae] Kircher’s story about how the *pescce spada* are captured, followed by further proofs of music’s power to affect and to heal living beings, can be found in *Musurgia universalis*, book 9 (1650, vol. 2, pp. 227 ff.), in the same context as the abovementioned.

freto Mamertino] i.e. the straits between Italy and Sicily, named after the *Mamertini*, the inhabitants of Messina (today’s Messina), who were de-

scendants of a group of mercenaries from Campania that had colonized the town in the 3rd century B.C.

non dubitet ipse Kircherus affirmare] The idea of the power to rouse affects in human beings is omnipresent in Kircher's *Musurgia* (1650), but he deals with the matter primarily in vol. 2, pp. 213 ff. and 422 ff.

affectus] The idea that music raises the affects of men is a commonplace at this time. After the sixteenth century and the revival of Classical rhetoric, it becomes ubiquitous in musical thought of the baroque period (Palisca 2006, pp. 179 ff.). In Descartes's *Musicae compendium* it is simply stated that slower measures raise slower affects, and swifter measures swifter affects (1978, p. 8):

Quod autem attinet ad varios affectus, quos varia mensura Musica potest excitare, generaliter dico, tardiores lentiores etiam in nobis motus excitare, quales sunt languor, tristitia, metus, superbia, etc, celeriores vero etiam celeriores affectus, qualis est laetitia etc ...

In Orostander's music primer from 1703, raising the affects is even stated to be the second most important aim of music, next to praising God: *Finis potissimus et primarius est laus et gloria Dei. Secundarius ut delectet variosque moveat affectus* (Lundberg & Sjökvist 2010, p. 68), and this second aim has almost been literally taken from the opening sentence of Descartes's *compendium*.

In thesis 85 of *De modis*, Vallerius renders *affectus* as equivalent to *animae passionēs*. In the dissertation *Animae ΠΑΘΗΜΑΤΑ ΟΙΚΕΙΑ* (1700), defended under Vallerius's presidency, such passions are later defined as 'commotions of the soul, which refer especially to all those things that are produced, conserved and corroborated by some peculiar motion of the spirits' (p. 21):

... passionēs sunt commotionēs animae, quae ad eam speciatim referuntur, quaeque producuntur, conservantur et corroborantur, per aliquem peculiarem motum spirituum.

Another treatment of the affects can be found in the dissertation *Meletematis philosophici de ingenio humano pars altera* (pp. 66 f.), defended under Vallerius's presidency in 1694.

de varia Musicae vi in nostris affectibus excitandis disserere] Vallerius now actually starts to introduce the subject of the next dissertation, the one called *De modis*, defended in Uppsala in 1686. As we can see in the first thesis (no. 84) of that dissertation below, he there quotes the part that follows here almost literally, and thereby establishes yet another link between them. The *praeteritio* of the final sentence of this thesis thus serves that end as well.

Notably, however, we see many similarities here with Descartes's discussion in the *Musicae compendium*. Descartes likewise in a few words stresses the importance of *tactus* for raising the affects of man, but refrains from dealing more closely with it, since great knowledge about the motions of the mind is necessary for that purpose (1978, p. 8):

Quod autem attinet ad varios affectus, quos varia mensura Musica potest excitare, generaliter dico, tardiores lentiores etiam in nobis motus excitare, quales sunt languor, tristitia, metus, superbia, etc., celeriores vero etiam celeriores affectus, qualis est laetitia, etc. ... Sed hujus rei magis exacta disquisitio pendet ab exquisita cognitione motuum animi, de quibus nihil plura.

Non omittam tamen tantam esse vim temporis in Musica, ut hoc solum quandam delectationem per se possit afferre ...

Later on in his compendium, Descartes after his treatment of different consonances once again explicitly omits dealing with the power of music on human beings. Nonetheless he states that the ditone and the major sixth are merrier than the minor third and the minor sixth (1978, p. 28):

Nunc sequeretur ut de variis consonantiarum virtutibus ad movendos affectus loqueremur, sed hujus rei disquisitio exactior potest elici a jam dictis, et compendii limites excedit. ... Id igitur tantum dicam hac de re, praecipuam varietatem ab his quatuor ultimis oriri, quarum ditonus et sexta major gratiores laetioresque sunt quam tertia et sexta minores ...

The theme of music raising the affects will therefore be treated more extensively below, but we can already notice here that Vallerius claims that it depends upon many different factors, both musical and human, but that he especially stresses the importance of the *tactus*.

Corollary:

Corollaria] The sense here, which is closer to 'appendix' (cf. *DMLBS*, s.v. *corollarium*, b; and *OED*, s.v. *corollary*, 3), has obviously developed from the late Latin usage of it as 'deductive additional clause' (*TLL*, Souter, cf. Krebs & Schmalz).

The aim of this kind of postponed sentences in academic dissertation of the time was often to give the respondent the opportunity to demonstrate his argumentative skills, by explaining and defending claims that are self-evident, pointless or even wrong. Not infrequently were they thus obviously meant even to be entertaining (cf. the *animi causa* at the end of *De modis*), forcing the respondent to convince the audience about a statement that everyone knew was false. In Vallerius's case here, there is a gradual progression from no. 1, which is logically consistent and true, to no. 5, which is obviously false.

In the corollary in the *Disputatio mathematica de triangulo* (1697), defended under Vallerius's presidency by his son Johannes, there are three statements that are similar to the ones here. There we meet, for instance, the claim (p. 25): *Datis duobus Triangulis inaequalibus, potest minus in infinitum augeri, ita tamen ut majori numquam fiat aequale.*

Gratulatio 2:

Venusinus Poëta] The Venusine poet is certainly Horace, who is said to have been born at Venosa (*Venusia*), on the border between Apulia and Lucania. Suetonius in the *Vita Horatii* (p. 40) explicitly introduces him as: *Q. Horatius Flaccus, Venusinus.*

The quotation that follows is taken from the first of Horace's odes, which begins with a grand address to Maecenas, or more precisely Hor. *carm.* 1.1.29–34. At the end of this poem, the main point of which is the author's desire to be counted among the Classical lyrical poets by Maecenas (cf. Nisbet & Hubbard 1970, p. 1), the quoted section appears. As we can see, Horace there expresses his absolute dependence upon the assistance of the Muses for his poetical enterprise to be successful.

With the quotation, Wallinus wants to establish a parallel between Vallerius and the great Roman poet, while also alluding to the academic ceremonies, with laurel coronations and the symbolic climbing of the Parnassus. Vallerius, who also dedicates himself to the Muses, raises above the ordinary people. The mention of the musical instruments of the Muses in Horace's passage also makes the lines especially suitable to the context.

publicam Lucem visura] The phrase refers to the act of publication. With models in Classical Latin (cf. *OLD*, s.v. *lux*. 3, d), similar expressions become customary circumlocutions of 'publication' in the printing period (cf. Krebs & Schmalz, and Hoven, s.v. *lux*, b–c).

Musicam ... in pretio habuisti ... cum omnium adplausu exercuisti] The words are praise, of course, but their claim is also verified from what we know of Vallerius's biography. He was a very skilled musician early in his life, and this also made him especially attractive to influential people at Uppsala university. As a boy he sang in the cathedral of his home town Linköping. As a student in Uppsala he attracted the attention of Olaus Rudbeck, received scholarships for several years as a musician, and even won public renown for his musical skill. Rudbeck also pleaded Vallerius's cause several times, then explicitly mentioning the many instruments Vallerius knew how to play (Hansson 1967, pp. 58 f.).

Academico hoc, quod meditatus es, exercitio] We here find the second explicit statement of the fact that Vallerius's dissertation on sound was only *pro exercitio*.

Musarum sacris] The Muses here, besides revoking Horace's quoted passage, as so often else in literature of the time, represent academic learning,

and their sacred rites at the academy (cf. Helander 2004, pp. 553 ff.). The following *hauseris*, besides referring to the acquisition of much knowledge, alludes to the Muses' spring Aganippe (or Hippocrene) on Mount Helicon, from which poets drank in order to receive inspiration (see further Sjökvist 2007, pp. 198 and 210).

a rudi plebe secernere atque Eruditorum choro dignum facere] The reference of course goes to Horace's above quoted lines, hence the somewhat surprising expression *Eruditorum choro* (who would not rather dance with nymphs?). The first part of this line also echoes of Hor. *carm.* 3.1.1: *odi profanum vulgus et arceo*, with its contempt of the taste of the common people.

vitam et mores aliorum de sociis homines non raro soleant aestimare]

The idea that you can judge a man from his friends is a commonplace, and recurs in several very old proverbial sayings (cf. Otto, p. 230. See e.g. also Walther & Schmidt, 2955, with references).

Musae in honoris ... culmen Te deduxerint] Cf. the commentary on the first *gratulatio* written by Andreas Norcopensis above. Once again *culmen* refers to the Parnassus, where Vallerius would be crowned with laurel when he has finished his studies and won the master's degree. The words can thus also allude to certain parts of the promotion ceremony.

exanthlati] The word, which is usually spelt either as *exantlo* or *exancio*, is typical of neo-Latin. While it was regarded as old-fashioned and poetical in Classical Latin, it is in neo-Latin texts and lexica not affected by such nuances. Not least it is frequently used regarding academic labours endured (Helander 2004, pp. 112 f.).

Andreas Sundius] Andreas Sundius was born in 1642 in the region of Jämtland in the Northern part of Sweden. He matriculated at Uppsala university 20 July 1664. In the registers the note on him is: *ex Jemptia et gymnasio Hernösandensi cum testim[onio]* (*Uppsala Universitets matrikel*, vol. 1, p. 181). He defended two dissertations: *De igne* (1673) under the presidency of Pehr Aurivillius, and *De systemate mundi Democriteo* (1674) under Magnus Celsius. He thus completed his studies in Uppsala in 1674, and returned to Härnösand for a position at the *gymnasium* and the consistory. This circumstance is well mirrored in the address to Vallerius, in which Sundius expresses his sadness of being separated from his friend (*recordor me ab Amico tam sincero jamjam divulgum iri*), since he is soon returning to his native region (*in patriam abiturus*). His master's degree was conferred on him 12 december 1682, himself being counted as the *primus* during the promotion ceremony. Having carried out the duty of *rector* of the *gymnasium* in Härnösand, he ended his days in 1705 as vicar in Boteå, having suffered from a severe disease for more than a decade (Bygdén 1923, pp. 137 f.).

Gratulatio 3:

Musica ... / ... Musarum nomine nomen habet] Alliterations and anaphoras dominate this short poem completely, by the connection of music with the Muses. Since these also represent academic learning, as we saw above, it is with *Musis et amatur ab ipsis* stated that music is a subject that is also well suited to the academy (remember that Vallerius's dissertation was the first on music to be defended in Uppsala), and with *Te quoque Musarum credimus ore loqui* that Vallerius's writing is eloquent and learned.

The idea that music has its name from the Muses is old, and can be found for example in Augustine (*ord.* 2.14.41): *musae, unde ista disciplina sensus intellectusque particeps musicae nomen invenit*, but also in Isidore (*orig.* 3.15.1).

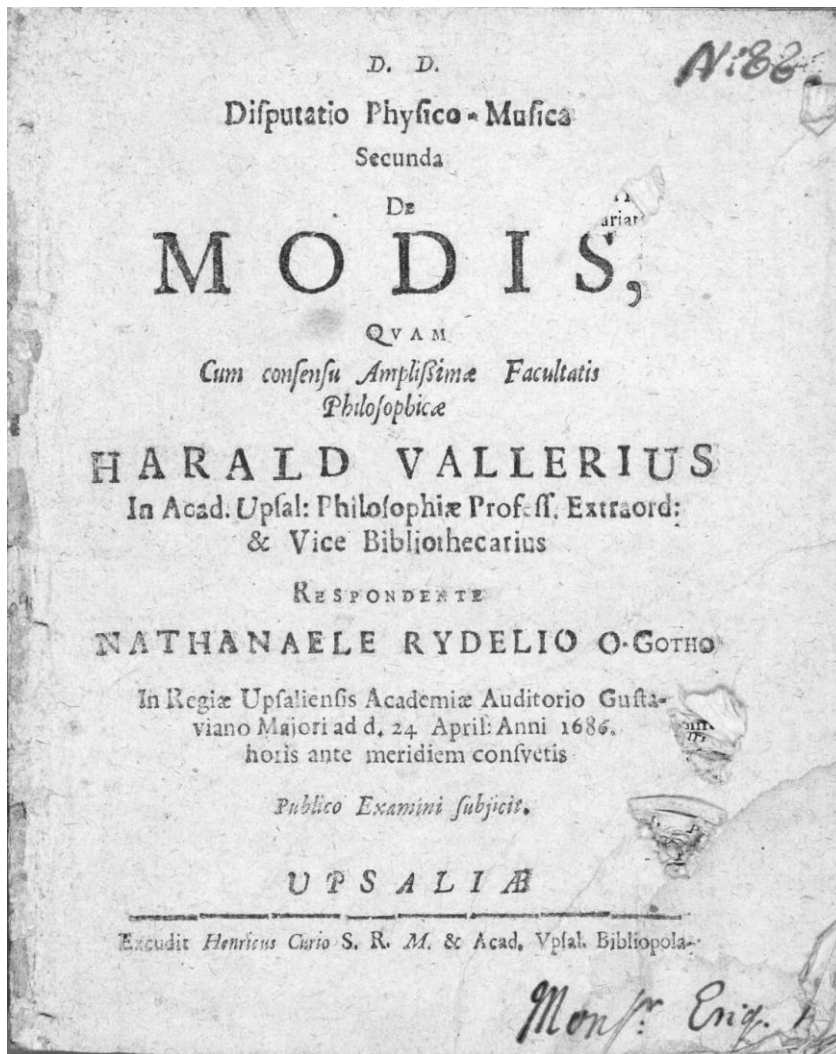
Moreover, the same second half of the pentameter line *nomine nomen habet* occurs twice in Ovid, viz. in *fast.* 3.411 and 6.21.

dum panditur abs te] A monosyllabic ending of a hexameter line was unusual in Classical Latin and labelled as improper by Quintilian (*inst.* 8.3.20). The poets usually avoided it as well, although support could be found even in Classical authors as Vergil and especially Horace (cf. Leonhardt 1996, p. 316).

Magnus Wallinus] Magnus Petri Wallinus was born 1646 in Törnevalla in Östergötland, as the son of a cavalry captain (*ryttmästare*), and was 15 years younger than his brother Carolus Petri Wallinus, Vallerius's predecessor as the *rector cantus* of Uppsala university, whose widow Vallerius had married when Carolus died, as we saw above. Magnus matriculated at Uppsala university on 8 February 1668, almost two years later than Vallerius, according to *Uppsala Universitets matrikel* (vol. 1, p. 198), and is some years later mentioned as one of the *musici* of the philosophical faculty (*Uppsala Universitet. Akademiska konsistoriets protokoll*, vol. IX, p. 55). A small note in the registers also says *Mortuus Upsaliae*. Wallinus namely died still a student in Uppsala only one year later, 23 November 1675 (Odén 1902, p. 67; and Kyhlberg, *Musiken i Uppsala II* [MTB]).

3 *Disputatio physico-musica secunda de modis*

3.1 Text and Translation



Deo Duce.

Disputatio Physico-Musica

Secunda

DE

MODIS,

QUAM,

Cum consensu Amplissimae Facultatis

Philosophicae,

HARALD VALLERIUS,

In Academia Upsaliensi Philosophiae Professor Extraordinarius

Et Vice Bibliothecarius,

RESPONDENTE

NATHANAELE RYDELIO Ostro-GOTHO,

In Regiae Upsaliensis Academiae Auditorio Gusta-

viano Majori ad diem 24 Aprilis Anni 1686

horis ante meridiem consuetis,

Publico Examini subjicit.

UPSALIAE,

Excudit *Henricus Curio* Sacrae Regiae Majestatis et Academiae Upsaliensis

Bibliopola.

Under the guidance of God.

A second physico-musical
disputation
on
modes,
which,
with the consent of the most renowned
philosophical faculty,
Harald Vallerius,
professor extraordinarius of philosophy and second librarian
at the Academy of Uppsala,
with Nathanael Rydelius from Östergötland
as respondent,
in the *Auditorium Gustavianum majus*
at the Royal Academy of Uppsala
24 April 1686 at the usual time *ante meridiem*,
subjects to public examination.

In Uppsala,
printed by Henricus Curio, bookseller of the Holy Royal Majesty and the
Academy of Uppsala.

VIRO.
Spectatissimo.
Vitaque. ac. prudentia.
maxime. Conspicuo.
DOMINO.
Domino. JOANNI. MARKER.
Senatus. Holmensis.
Adsessori. et. Consiliario.
Justissimo. Dignissimo.
Patrono. ac. NUTRITIO. MEO.
perpetim. Colendo.
Suspiciendo.
in.
Observantiam. debitam.
Conamina. qualiacunque. mea.
Offero.
Dico. Consigno.
Ipsi.
qui.
VIVO.

Officiis. semper.
Adstrictissimus.
NATHANAEL. RYDELIUS.

To the most
illustrious man,
highly conspicuous for his life
and his prudence,
lord
Johan Marker,
most just and worthy
assessor and counsellor
of the Council of Stockholm,
my patron and fosterer,
who should always be honoured
and esteemed
with due observance,
to him I offer,
dedicate and consign
my endeavours of whatever kind they are,
who
live

always under greatest obligation
because of his favours.
Nathanael Rydelius

Thesis LXXXIV.

De Soni natura, quatenus Physice considerantur, in Superioribus pro ingenio nostro breviter egimus. Hoc ipso enim Soni productionem, tam ex ipsa natura quam per varia Instrumenta Musica, nec non ejusdem variationes pro diversa objectorum ac medii habitudine, ut et ejus propagatione, reflexione, tonorum inter sese proportionem quoad vibrationes ac numeros, atque exinde ortis Consonantiis et Dissonantiis eorumque simplicitate ac perfectione, imo ejusdem Soni rationem Musicam secundum Longitudinem, Latitudinem ac Profunditatem, prout a nobis pro ratione instituti tunc temporis fieri potuit, demonstravimus. Ex hac vero occasione in sequentibus quoque, ut dictum fuit th. 83, nobis declarandum superest, unde *varia Musicae vis in nostris affectibus excitandis oriatur, ut quod Tactus tardiores motus et affectus in nobis generent tardiores, quales sunt languor, tristitia, metus, etc., et Tactus velociores affectus excitent celeriores, quales sunt amor et laetitia etc., et praeterea quomodo hi affectus ratione Instrumentorum, Modorum, Consonantiarum et Dissonantiarum sede ac combinatione, etc., denique etiam secundum varia cujusque temperamenta, spirituum magnitudinem, aequalitatem, motus celeritatem vel tarditatem, secundum aetates, sexus, anni tempora et tempestatum varietates etc., singulos homines varie afficere possint, et quae fortassis sunt alia.*

Thesis LXXXV.

Sonorum autem artisque Musicae non ad animos solum hominum commovendos, Variosque eorum affectus ac animae passiones, secundum variam suam atque indefinitam tonorum atque notularum combinationem ac dispositionem, diversimode excitandos sedandosque summam esse efficaciam, sed etiam in reliqua corpora, tam dura quam fluida, valide concutienda maximam eamque satis admirandam esse vim, non tantum Philosophi uno ore demonstrant vel concedunt omnes, sed etiam experientia ipsa apud singulos homines, tam intra quam extra sese, clarius testatur quam ut idipsum vel enumerare vel etiam probare necessarium ducamus. Ut enim ea, quae vel tamquam miraculosa et extraordinaria, adeoque huc non spectantia, vel etiam quae tanquam superstitiosa vel prorsus Diabolica, vel demum quae per artem fortassis Oratoriam apud Auctores varios, de hoc negotio nobis traduntur, silentio nunc praetereamus, non certe sine jucunditate maxima non tantum unusquisque tam apud seipsum sentiet, quam cum admiratione summa in aliis observabit, et unam et eandem Cantilenam vel Melodiam secundum artem Musicam concinne prolatam, pro varia Sonorum habitudine tonorumque collocatione,

Under the guidance of God.

Thesis 84.

With the nature of sound, as far as it is examined from a physical perspective, we dealt briefly above in accordance with our abilities. For thereby we explained the production of sound, both from nature itself and by different musical instruments, but also its variations depending on the different conditions of the objects and the medium, as well as on its propagation, its reflection, the proportion of its tones in relation to each other as regards their vibrations and numbers, and the thereby created consonances and dissonances, and their simplicity and perfection. Yes we even explained the musical principles of this same sound according to duration, volume and pitch, as far as we could do this at that time in accordance with the plan of the undertaking. But from this occasion it also remains for us to show in the following, as was mentioned in thesis 83, from where ‘the different powers of music for exciting our affects come about, for example that slower *tactus* generate slower motions and affects in us, such as weariness, sadness, fear, etc., and faster *tactus* excite faster affects, such as love and happiness, etc., and moreover how these affects can affect each and every man differently depending on the instruments, the modes, the positions and combinations of consonances and dissonances, etc., and finally also according to everyone’s different temperaments, magnitude and consistency of mind, the speed or slowness of the motion, according to age, sex, season and different kinds of weather, etc., and perhaps there are other things’.

Thesis 85.

That the efficacy of sounds and the musical art are not only very great for rousing the minds of men, and for exciting and restraining their different affects and emotions in different ways, in accordance with their endlessly different combinations and arrangements of tones and notes, but also that their power is very great and admirable enough for strongly exciting other bodies, both solid and fluid ones, all philosophers not only show with one voice or agree to, but even experience itself in each and every man, both inside and outside of him, demonstrates so clearly that we neither consider it necessary to recount nor even to prove this very circumstance. For although we now pass this by in silence, which in various authors on this matter is either handed down to us as miraculous and extraordinary, and which in addition does not belong here, or even as superstitious or thoroughly diabolical, or finally perhaps handed down through the discipline of rhetoric, surely each and every man not without greatest delight not only feels as much in himself, as he with greatest admiration observes in others, that one and the same song or melody that is skillfully delivered in accordance with musical art produces different, yes even quite opposite, effects, depending on

ut et pro hominum secundum aetates, sexus, praejudicia, complexiones aliasque innumeras conditiones varia dispositione, alios, imo contrarios prorsus, effectus producere. Sed etiam alias aliasque Cantilenas varie item ordinatas in iisdem saepe hominibus eosdem affectus excitare unicuique experiri facile licebit.

Thesis LXXXVI.

In hominum vulgo, qui affectus suos et animae passiones ita vel fingere vel sedare non didicerunt, hoc longe clarissimum erit. Prout enim cujusque animus ex variis causis jam ante commotus vel praeoccupatus fuerit, licebit cernere unum ex eadem Cantilena contristari et flere, alterum simul in summo gradu adeo hilarem ac laetum fieri, ut a saltu aliisve gestibus se continere vix queat.

Thesis LXXXVII.

Apud Philosophos quaeritur jam hujus rei ratio ac causa – et certe factum est hoc in negotio idem ac in multis aliis Philosophiae partibus, quod effectus nobis a posteriori sese manifeste quidem produnt – circa rationem vero ejus reddendam valde haesitant. Hinc etiam fit quod illis ipsis rebus, quae hos effectus comitantur, causam saepissime tribuamus, quum tamen ejus causa non verius sit quam est aditus hominis in urbem causa quod pluatur. Unde itaque varius ille effectus quam maxime proveniat, in sequentibus demonstrare conabimur. Impraesentiarum tamen ea tantum, quae a Philosophis de hisce adduci communiter solent, animus est in medium proferre.

Thesis LXXXIX.

Philosophi maximam hujus rei causam ut plurimum tribuere solent *Modis*, ut vocant, *Musicis*. Per Modos autem Harmonicos hic intelligimus certa tonorum intervalla ex 7 Octavae speciebus et gradibus orta, intra quae unaquaeque Cantilena quam maxime contineri solet. In quolibet enim ex hisce Modis tres sunt termini primarii, intra quos unaquaeque Cantilena, praesertim in suis clausulis Principalibus, fere contineri solet. Atque hanc ob causam, quia limites et Modum Cantilenis hac ratione praescribunt, etiam Modos dictos esse existimamus.

Thesis XXCIX.

Quod spectat ad numerum Modorum, de eo veteres et recentiores Auctores inter sese prorsus dissentiunt. Quidam enim 14, alii 12, alii 8, 7, 6, alii demum quatuor statuerunt. Quamvis autem juxta 7 Octavae gradus in Scala Musica duplicatos, si illos secundum latitudinem suam consideremus,

the different arrangement of the sounds and the position of the tones, as well as on people's different dispositions concerning age, sex, prejudices, complexion and uncountable other conditions. But it is also very easy for everyone to find out that many different songs that are likewise arranged in different ways often excite the same affects in the same people.

Thesis 86.

Among the common people, who have scarcely learnt to control or to restrain their affects and emotions, this is most evident by far. For just as everyone's mind is already agitated or preoccupied beforehand for different reasons, it is possible to see that one becomes sad and cries from the same song, while at the same time another to a very great degree becomes so cheerful and happy, that he can hardly restrain himself from dances and other gestures.

Thesis 87.

Among the philosophers the explanation and cause of this circumstance is sought – and certainly the same has happened in this matter as in many other parts of philosophy, since the effects admittedly reveal themselves to us in an evident way *a posteriori* – but they hesitate greatly when it comes to rendering its explanation. This is also why we very often attribute the cause to those very things which are connected to these effects, although its cause may still be not more true than that a man's entry into a town is the cause of rain. We shall thus in the following try to explain from whence this varying effect mostly arises. But for the moment my intention is to present only that which is usually adduced by the philosophers on these matters.

Thesis 88.

The philosophers for the most part usually ascribe the greatest cause of this circumstance to the musical modes, as they call them. With the harmonic modes we here understand certain intervals of tones that have come about from the seven species and steps of the octave, within which each and every song is usually confined as much as possible. For in any of these modes there are three primary terms, within which every song is usually confined, especially in its principal cadences. And for this reason, since they in this way prescribe the limits and the measure for the songs, we may also suppose that they were called modes.

Thesis 89.

As regards the number of the modes, about this the ancient and the contemporary authors completely disagree with each other. For some have established that there are fourteen, others twelve, others eight, seven, six, and others finally only four. Although fourteen modes come about according to the doubled seven steps of the octave in the musical scale, if we should

14 proveniant Modi, quia tamen in duobus locis falsa quinta loco quintae in scala Diatonica reperiatur, adeoque Cantilenam constituerit minus naturalem, idcirco Philosophi recentiores duobus hisce rejectis 12 tantum Modos tanquam legitimos posuerunt. Et sicut de numero Modorum maximus est Auctorum dissensus, ita nec magis de ordine eorum inter sese conveniunt. Quia vero haec parum vel nihil ad nostrum jam faciunt institutum, idcirco etiam de talibus, sicut et de ratione appellationum eorundem, in praesentia nec multum solliciti sumus.

Thesis XC.

Sunt illi Modi: *Dorius*, *Hypodorius*, *Phrygius*, *Hypophrygius*, *Lydius*, *Hypolydius*, *Myxolydius*, *Hypo-Myxolydius*, *Ionius*, *Hypo-Ionius*, *Jastius*, *Hypo-jastius*. Ut autem clariora haec evadant, Modos hosce schemate sequenti per claves Musicas exponere necessum duximus.

Dorius	Hypodorius	Phrygius	Hypophrygius	Lydius	Hypolydius
d d A F D	a a F D A	e e H G E	h h G E H	f f C A F	c c A F C
1.	2.	3.	4.	5.	6.

Myxolydius.	Hypomixol.	Ionius.	Hypoion.	Jastius.	Hypo-jastius.
g g D H G	d d H G D	a a E C A	c c C A E	c c G E C	g g E C G
7	8.	9.	10.	11.	12.

Thesis XCI.

Quod jam ad Harmonicam Chordae divisionem pertinet, potest illa in sua intervalla dividi vel in ordine ac relatione ad seipsam, vel etiam in ordine ad intervalla et consonantias ad se invicem relatas. Illo modo divisa nobis magis inservit in ipsa praxi, et ad instrumenta Musica, quatenus illa seorsim considerantur, commodius applicatur, ubi etiam locum semper obtinet. Si vero ad intervallorum inventionem eorumque mutuam ad se invicem proportionem, perfectionem, simplicitatem reliquasque qualitates respiciamus, haec omnia modo posteriori facilius demonstrantur.

consider them according to their range, since a false fifth can be found instead of the fifth in two places in the diatonic scale, and in addition makes the song less natural, contemporary philosophers have rejected these two and established only twelve modes as proper ones. And just as there is a great disagreement between the authors on the number of the modes, neither do they agree with each other any better about their order. But since this contributes little or nothing at all to our undertaking, we are at present neither much concerned with such matters, nor with an explanation of their designations.

Thesis 90.

These are the modes: dorian, hypodorian, phrygian, hypophrygian, lydian, hypolydian, mixolydian, hypomixolydian, jonian, hypojonian, jastian and hypojastian. In order for this to become clearer, we have considered it necessary to display these modes in the following figure by their musical clefs.

Dorius	Hypodorius	Phrygius	Hypophrygius	Lydius	Hypolydius
d d A F D	a a F D A	e e H G E	h h G E H	f f C A F	c c A F C
1.	2.	3.	4.	5.	6.
Myzolydius.	Hypomixol.	Ionius.	Hypejon.	Iastius.	Hypoastius.
g g D H G	d d H G D	a a E C A	c c C A E	c c G E C	g g E C G
7	8.	9.	10.	11.	12.

Thesis 91.

As regards the harmonic division of the string, this can be divided into its intervals either in an order in relation to itself, or in an order in relation to the intervals and consonances that are mutually related to each other. Divided in the former way it is of more use for us in practice itself and more suitably applied to musical instruments, as far as these are examined separately, and there it also always fulfils a function. But if we turn our attention to an investigation of the intervals, and their mutual proportion in relation to each other, their perfection, their simplicity and their other qualities, all of these are more easily explained in the latter way.

Thesis XCII.

Est autem proportio intervallorum Musicorum in numeris radicalibus haec:

Comma ut 80 ad 81.

Semitonium minus ut 25 ad 24.

Semitonium majus ut 16 ad 15

Tonus minor ut 10 ad 9.

Tonus major ut 9 ad 8.

Tertia minor ut 6 ad 5.

Tertia major ut 5 ad 4.

Quarta ut 4 ad 3.

Tritonus ut 45 ad 32.

Semidiapente ut 64 ad 45.

Quinta ut 3 ad 2.

Sexta major ut 5 ad 3.

Sexta minor ut 8 ad 5.

Septima minor ut 9 ad 5.

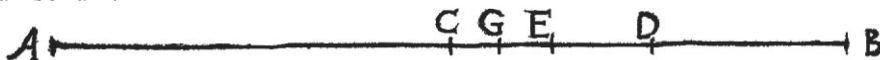
Septima major ut 15 ad 8.

Octava ut 2 ad 1.

Reliquas dissonantias et intervalla composita jam praetereo. Illa autem vide apud Kircherum, *Musurgia*, lib. 3, Mersennum, *Harmonia*, lib. 4, Riccioli, *Almagestum*, lib. 9, sect. 5, aliosque.

Thesis XCIII.

Sit jam Chorda *AB*, dividaturque illa secundum posteriorem rationem in duas partes aequales in *C*. Dabit *AC* vel *CB* ad *AB* Octavam, et *AC* ad *CB* unisonum.



Praeterea dividatur *CB* bifariam in *D*. Sonabit *AD* ad *AB* quartam, et *AC* ad *CD* vel *DB* Octavam, et *AD* ad *AC* Quintam, et *AD* ad *CD* duodecimam, *CD* et *DB* unisonum, et denique *DB* ad *AB* bisdiapason.

Porro dividatur *CD* bifariam in *E*. Producet *AC* ad *AE* tertiam majorem, *AD* ad *AE* tertiam minorem, et *AE* ad *CE* decimam septimam majorem, et *AC* ad *CE* decimam quintam, *AD* ad *ED* decimam nonam, et denique *AB* ad *AE* sextam minorem, et *AB* ad *BE* undecimam. Ulterius dividatur jam *CE* bifariam in *G*. Sonabit *AC* ad *AG* tonum majorem, et *AG* ad *AE* tonum minorem. Et denique *GE* divisa bifariam in *F*, producet *AB* ad *AF* sextam majorem, et *AC* ad *CF* tertiam minorem, ut reliqua taceam intervalla. Atque ita ex sola hac chordae divisione in partes duas aequales primaria intervalla Musica habebimus.

Thesis XCIV.

Nolo jam ulterius haec deducere, et quomodo ex hac Consonantiarum divisione oriantur gradus reliqui, per quos ad jucunditatem Musices ab una Consonantia ad aliam transitum facimus. Hi enim gradus in scala Diatonica non sunt nisi tonus major et tonus minor, semitonium majus et semitonium minus. Et quia illi gradus ex Consonantiarum intervallis oriuntur, non possunt in una Octava nisi 7 ordinarii hinc produci,

Thesis 92.

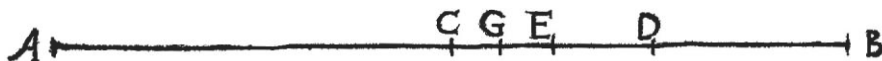
This is the proportion of the musical intervals in root numbers:

The comma as 80 to 81.	The tritone as 45 to 32
The minor semitone as 25 to 24.	The semidiapente as 64 to 45
The major semitone as 16 to 15.	The fifth as 3 to 2.
The minor tone as 10 to 9.	The major sixth as 5 to 3.
The major tone as 9 to 8.	The minor sixth as 8 to 5.
The minor third as 6 to 5.	The minor seventh as 9 to 5.
The major third as 5 to 4.	The major seventh as 15 to 8.
The fourth as 4 to 3.	The octave as 2 to 1.

I omit mentioning the remaining dissonances and composite intervals. See these in Kircher, *Musurgia*, book 3, Mersenne, *Harmonia*, book 4, Riccioli, *Almagestum*, book 9, section 5, and others.

Thesis 93.

Let there be a string AB, and let this be divided into two equivalent parts at C according to the latter principle. AC or CB to AB brings about an octave, and AC to CB a unison.



Let thereafter CB be divided into two parts at D. AD to AB sounds a fourth, and AC to CD or DB an octave, and AD to AC a fifth, and AD to CD a twelfth, CD and DB a unison, and finally DB to AB a bisdiapason.

Let furthermore CD be divided into two parts at E. AC to AE produces a major third, AD to AE a minor third, and AE to CE a major seventeenth, and AC to CE a fifteenth, AD to ED a nineteenth, and finally AB to AE a minor sixth, and AB to BE an eleventh. Let now CE be further divided into two parts at G. AC to AG sounds a major tone, and AG to AE a minor tone. And when finally GE has been divided into two parts at F, AB to AF produces a major sixth, and AC to CF a minor third, not to mention the remaining intervals. And thus we have the primary musical intervals from only this division of the string into two equivalent parts.

Thesis 94.

I do not want to deduce this further, and to say how the remaining steps come about from this division of consonances, by which we make a transition from one consonance to another to the delight of music. For in a diatonic scale these steps are nothing but a major tone and a minor tone, a major semitone and a minor semitone. And since these steps come about from the intervals of consonances, nothing but the seven ordinary ones can

qui sunt UT, RE, MI, FA, SOL, LA, SI, ut ex ipsa praxi unicuique satis manifestum est. Constat una Octava hac ratione tribus tonis majoribus, duobus minoribus, atque duobus semitoniis majoribus. Eo autem ordine inter sese sunt illi gradus in Scala Musica collocandi, ut tonum majorem, quantum fieri poterit, subsequatur tonus minor, et post duos tonos necessario semitonium. Quod semitonium hoc in loco tam necessarium et unicuique adeo naturale est, ut etiam ipsi Rustici, mulieres ac quivis alii (quod mirum forte nonnullis videbitur) in cantu hoc ipsum ad evitandum tritonum observent. Quod nisi fierit, nulla daretur neque Quarta neque Quinta, quibus tamen carere non possumus.

Thesis XCV.

Ex hoc fundamento et 7 illis Octavae gradibus deducti sunt illi 14 *Modi Musici*, quorum in superioribus facta est mentio. Posito enim, juxta ea quae jam dicta sunt, quod post duos vel tres tonos necessario sequatur in scala Musica semitonium, habet Octava prima in D semitonium primum in secundo, alterum vero in sexto gradu. Secunda Octava in E habet semitonia in primo et quinto loco. Tertia in F in quarto et septimo loco. Quarta Octava in G in tertio et sexto gradu. Quinta Octava in A in secundo et quinto gradu. Sexta Octava in H in primo et quarto loco. Et denique septima Octava in C sua habet semitonia in tertia et septima sede. Nec alia in scala Musica combinatio fieri potest. Hae 7 Octavae species si jam duplicentur, 14 exinde oriuntur *Modi*, ex quibus tantum 12 ob rationes jam allatas retinentur.

Thesis XCVI.

Si vero Chordam juxta cujusvis intervalli proportionem in numeris th. XCII datis dividere voverimus, fiet illud in chorda AB hoc modo: Habet se Octava ut 2 ad 1. Chorda itaque AB divisa in partes tres, ut in C et D, dabit AC ad CB Octavam. Hoc est, dum CB facit unam, facit AC duas vibrationes.



Si dividatur chorda AB in partes aequales 5, sonabit AC ad CB Quintam, ut 2 ad 3. Hoc est, dum CB absolvit duas, absolvit AC vibrationes tres.



be produced hereby in one octave, and these are UT, RE, MI, FA, SOL, LA, SI, which is evident enough for everyone from practice itself. In accordance with this principle one octave consists of three major tones, two minor ones, and two major semitones. The steps should then be placed in such an order in relation to each other on the musical scale, that a minor tone follows directly upon a major tone as often as possible, and after the two tones necessarily a semitone follows. The semitone in this place is so necessary and so natural to everyone, that even peasants, women and anyone else (this perhaps seems strange to many people) observe this very circumstance in order to avoid the tritone while singing. If this should not be the case, there would be neither a fourth nor a fifth, but we cannot be without these.

Thesis 95.

From this foundation and from the seven steps of the octave the fourteen musical modes are deduced, which were mentioned above. For having posited, in accordance with what has already been said, that a semitone necessarily follows after two or three tones in a musical scale, the first octave in D has the first semitone at the second, but the other at the sixth step. The second octave in E has the semitones in the first and in the fifth place. The third in F in the fourth and seventh place. The fourth octave in G at the third and sixth step. The fifth octave in A at the second and fifth step. The sixth octave in H in the first and the fourth place. And finally the seventh octave in C has its semitones in the third and the seventh position. And there can be no other combination in the musical scale. If these seven species of the octave are now doubled, fourteen modes come about thereby. From these only twelve are retained, for reasons already accounted for.

Thesis 96.

But if we want to divide a string according to the proportion of any interval in the numbers given in thesis 92, this is done in this way in the string AB: The octave is as 2 to 1. When the string AB has thus been divided into three parts, for example at C and D, AC to CB brings about an octave. That is, while CB produces one, AC produces two vibrations.



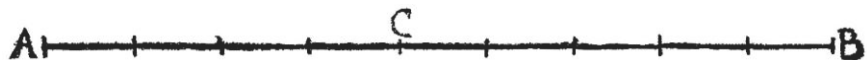
If the string AB is divided into five equal parts, AC to CB sounds a fifth, as 2 to 3. That is, while CB detaches two, AC detaches three vibrations.



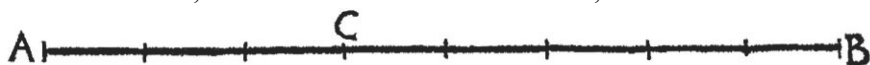
Eadem Chorda AB divisa in partes aequales 7, producet AC ad CB Quartam, ut 3 ad 4. Hoc est, dum CB perficit tres, perficiet AC quatuor vibrationes.



Chorda AB divisa sit in partes 9. Dabit AC ad CB tertiam majorem, ut 4 ad 5. Hoc est, eodem tempore quo CB quater, AC quinques recurret.



Chorda AB divisa in partes aequales 8, sonabit AC ad CB sextam majorem, ut 3 ad 5. Hoc est, dum CB tres absolvit vibrationes, absolvet AC 5.



Si chorda eadem divisa fuerit in partes aequales 17, producet AC ad CB tonum majorem, ut 8 ad 9. Hoc est, dum AC reddit 9, reddet CB octo vibrationes.

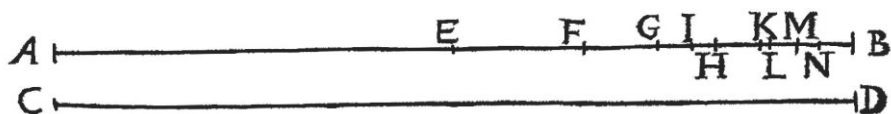


Hoc modo in omnibus reliquis intervallis majoribus et minoribus, juxta proportionem in numeris datam, procedere licebit. Quod quia unicuique in confesso est, ulterius brevitatis causa nunc non extendimus.

Thesis XCVII.

Quod si vero Chordam priori modo, in ordine ad seipsam, dividere voluerimus, fit illud juxta proportionem in numeris datas modo sequenti.

Sit Chorda AB, et ut commodius hoc practice fiat, ponatur illa in duplo, hoc est alia CD omni ratione priori prorsus aequalis, ut una

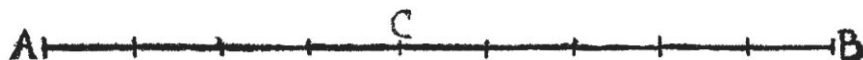


intacta maneat. Jam AB divisa bifariam in E, dabit AE vel EB ad CD Octavam, ut 2 ad 1. Eadem AB divisa in partes tres, ut in F,

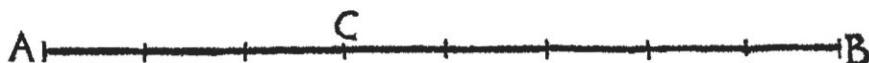
When the same string AB has been divided into seven equal parts, AC to CB produces a fourth, as 3 to 4. That is, while CB brings about three, AC brings about four vibrations.



Let the string AB be divided into nine parts. AC to CB brings about a major third, as 4 to 5. That is, in the same time as CB recurs four times, AC recurs five times.



When the string AB has been divided into eight equal parts, AC to CB sounds a major sixth, as 3 to 5. That is, while CB detaches three vibrations, AC detaches five.



If the same string is divided into seventeen equal parts, AC to CB produces a major tone, as 8 to 9. That is, while AC renders nine, CB renders eight vibrations.

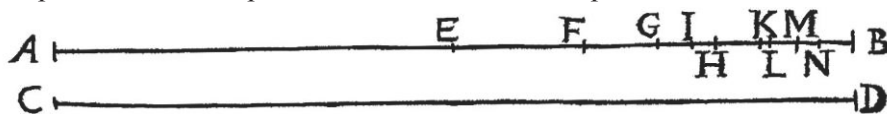


In this way it is possible to proceed in all remaining major and minor intervals, in accordance with the proportion given in the numbers. Since this is evident to everyone, for the sake of brevity we do not extend it further now.

Thesis 97.

But if we want to divide the string in the previous way, in an order where it relates to itself, this is done in the following way according to the proportions given in the numbers.

Let there be a string AB, and for this to become more suitable in practice, let it be set out in the duple, that is another CD that is entirely equivalent to the previous in all respects, so that it remains unimpaired as one.



When AB has been divided into two parts at E, AE or EB to CD produces an octave, as 2 to 1. When the same AB is divided into three parts, for example

sonabit *AF* ad *CD* Quintam, ut 2 ad 3. Ita eadem divisa in *G*, erit *AG* ad *CD* Quarta, ut 3 ad 4. Eadem ratione *AI* ad *CD* dabit tertiam maiorem, *AH* ad *CD* tertiam minorem. *AK* ad *CD* tonum maiorem, *AL* ad *CD* tonum minorem. *AM* ad *CD* semitonium majus, denique *AN* ad eandem *CD* semitonium minus, et ita in reliquis intervallis omnibus.

Thesis XCVIII.

Hisce breviter ita praemissis, ut ad Modos nostros eorumque efficaciam in animos hominum, cujus causa haec omnia adducta sunt, jam revertamur, observandum est nec etiam in hisce determinandis convenire inter sese Auctores Musices. Nolo vero jam varias veterum opiniones de Modis hisce adducere. Qui enim illas desiderant, praeter alios Kircheri artem magnam Consoni et Dissoni, lib. 7, pag. 554, consulere poterunt. Notandum tamen est iudicium ipsius Kircheri de hisce veterum opinionibus. Post enumerationem enim tandem concludit: Atque hi sunt affectus, quos duodecim Tonis attribuant Veteres. In quibus tamen minime sibi constant, estque tanta in hujusmodi determinandis confusio, ut cui subscribas nescias. Quem enim alii jucundum, alii severum, quem castum alii, alii lascivum, quem dein hilarem, alii lachrymosum appellant.

Thesis XCIX.

In pag. vero 573 et sequentes suam demum mentem de Modorum vi exponit Kircherus, eamque exemplis probare conatur, cui nos etiam subjungimus mentem Domini Milliet in *Musica*, prop. 24, quamvis eadem ex Petri Gassendi *manuductione ad Theoriam Musicam*, cap. 4, desumsisse videatur.

Primus Modus affectibus religionis, et pietatis et amoris in Deum mirifice servit. Habet enim nescio quid energiae mirabilis, qua fiducia quadam suavissima rapit animam, eamque coelestium rerum amore complet. Hic Modus Milliet dicitur gravis, idoneus ad res graves et serias exprimendas.

Secundus Modus modestam et religiosam laetitiam prae se fert, unde ad laudes Dei concinendas aptissimus est. Est enim hilaris et gravi tripudio plenus. Animat affectum et ad coelestis patriae gaudia traducit. Hunc Milliet vocat flebilem et supplicem, quod moestitiae, miseriae et sollicitudinum sit idoneus.

Tertius Modus moestitiam, gemitus, querelas, lachrimas proprie amat, et si cum artificiosa gravitate instituitur, dici vix potest quantum efficaciae ad animam in dolorem, lacrimas, commiserationemque concitandum habeat. Milliet dicit eum esse severum, austerum et imitem, res arduas et difficiles explicare.

at F, AF to CD sounds a fifth, as 2 to 3. When the same is thus divided at G, AG to CD is a fourth, as 3 to 4. In the same way AI to CD produces a major third, and AH to CD a minor third. AK to CD a major tone, AL to CD a minor tone. AM to CD a major semitone, and finally AN to the same CD a minor semitone, and likewise in all remaining intervals.

Thesis 98.

Having first mentioned these things in such a way, that we may now return to our modes and their efficacy on human minds, because of which all of this has been adduced, it should be noted that the musical authors do not even agree with each other in the definition of them. However, I do not want to adduce the different opinions of the ancients on these modes now. For those who wish to know about them can consult Kircher's *Ars magna consoni et dissoni*, book 7, page 554, among others. Kircher's own judgment of these opinions of the ancients should nevertheless be observed. For after the enumeration he finally concludes: 'And these are the affects, which the ancients attribute to the twelve tones. But on these they do not agree with each other at all, and there is such a great confusion in the definitions of this kind, that you do not know whom you should support. For the one that some call delightful, others call serious, the one that some call chaste, others call dissolute, the one that some then call hilarious, others call tearful'.

Thesis 99.

But on pages 573 and the following Kircher expounds his own view on the power of the modes, and he tries to prove it with examples. To this we also attach the view of Milliet in *Musica*, proposition 24, although he seems to have taken this from the *Manuductio ad Theoriam Musicam* of Pierre Gassendi, chapter 4.

The first mode 'wonderfully serves the affects of religion, both piety and love of God. For it has I do not know what kind of marvellous energy, by which it lays hold of the soul with some kind of very sweet confidence, and fills it with love for heavenly things'. This mode is by Milliet called 'grave, suitable for expressing grave and serious matters'.

The second mode 'displays a modest and pious happiness, and therefore it is most suitable for singing praises to God. For it is cheerful and full of intense dancing. It rouses the affect and leads to the delight of the heavenly fatherland'. Milliet calls this one 'tearful and suppliant, since it is suitable for sadness, misery and worries'.

The third mode 'especially loves sadness, laments, complaints and tears, and if it is set about with an artful gravity, it can hardly be said how great an efficacy it has for rousing the soul to pain, tears and compassion'. Milliet says that it is 'stern, austere and harsh, and that it deals with troublesome and difficult matters'.

Quartus Modus *similis est tertio, amat enim moestitiam et dolorem cum indignatione quadam, et effervescencia sanguinis cujusmodi iis, qui vehementi dolore in lachrimas et ejulatus solvuntur, evenire solet. Milliet vult eum esse Assentatorem adulationibus, querimoniis et languoribus amantium accommodatum.*

Quintus Modus *hilaris, Majestate plenus, ad ardua animam elevans. Nescio quid efficaciae ad animum in heroicas virtutes concitandum obtineat. Hic Milliet vocatur hilaris, alacer et laetitiam generans.*

Sextus Modus *habet in repercussionibus nescio quid severissimae hilaritatis et bellicae incitationis. Unde Tubis et Tympanis ad animos in ferocem dissolutionem et vehementiam bellicam incitandos aptissimus est. Apud Milliet est religiosus, quod usurpetur in poenitentia et lachrimis.*

Septimus Modus *natura subtristis, querulus, amorusus, zelotypus, voluptuosus. Amores molles ac adhaesionem dilecti pulchre exprimit. Milliet vero Iracundus.*

Octavus Modus *hilaris, vagus, jucundus. Hominem exprimit honestis et pulchris rebus intentum. Castitatis et temperantiae custos est. Milliet appellat pudicum, quod suavitatem aliquam prae se ferat.*

Nonus Modus *natura timidus, curis et sollicitudine plenus, cum spe tamen et fiducia conjunctus. Animum inter spem metumque positum pulchre exprimit. Milliet judicio est politus, et lyricis versibus accommodatus.*

Decimus Modus *flebilis, amorusus, mollis. Hominem molli conversationi deditum exprimit. Rebus spiritualibus et pietatis operibus, si remittatur, aptus est. Si intendatur, in lasciviam ac molliem animi, amoresque mundanos facile rapit. Apud Milliet appellatur luctuosus.*

Undecimus Modus *natura vagus, pulcher, harmoniosus, magnificus, et Regia Majestate plenus. Milliet ad tripudia et choreas est comparatus, diciturque propterea lascivus.*

Duodecimus Modus *natura severus, vagus, vehemens. In choleram, ubi intensior fuerit, facile inflammat. Unde bellicosus rebus et ferociam sive severitatem quandam prae se ferentibus aptissimus est. Ex sententia Domini Milliet est languens et lamentabilis, ad affectus praecipue amatorios exprimendos. His adde quae habet Kircherus, lib. 8, pag. 51 et pag. 142.*

Thesis C.

Haec jam de Modorum vi atque efficacia ad affectus nostros excitandos ex ipso Kircheri ac Domini Milliet seu Gassendo producere volumus, quia sunt ipsi inter Philosophos recentiores, et quidem inter eos qui nobis

The fourth mode 'is similar to the third, for it loves sorrow and pain with some indignation, and an excitement of the blood of this kind is usually the result for those who are carried off by violent pain into tears and wailing'. Milliet wants it to be 'a flatterer, suited to the adulations, complaints and weariness of loving people'.

The fifth mode is 'cheerful, full of majesty, raising the soul to the heights. I do not know what kind of efficacy it possesses for exciting the mind into heroic virtues'. By Milliet this one is called 'cheerful, brisk and generating happiness'.

The sixth mode 'has I do not know what kind of stern cheerfulness and warlike incitation in its repercussions. Therefore it is very suitable to trumpets and drums for stirring the minds to fierce dissoluteness and warlike violence'. In Milliet it is 'pious, since it is usually employed in penitence and sorrow'.

The seventh mode 'by nature is rather sad, querulous, amorous, jealous and lustful. It beautifully expresses sweet loves and an adhering to the beloved'. But in Milliet it is 'irascible'.

The eighth mode 'is cheerful, inconstant and delightful. It expresses a man that applies himself to honourable and respectful matters. It is the protector of chastity and temperance'. Milliet calls it 'decent, since it displays a kind of pleasantness'.

The ninth mode is 'timid by nature, full of worries and anxieties, but still connected to hope and confidence. It beautifully expresses a mind that is located between hope and fear'. In the judgment of Milliet it is 'refined, and suited to lyrical verses'.

The tenth modus is 'tearful, amorous and tender. It expresses a man that is devoted to gentle conversation. If it is lowered in pitch, it is suitable to spiritual subjects and pious efforts. If it is raised in pitch, it easily carries off to unruly behaviour and weakness of mind, and to love for worldly matters'. In Milliet it is called 'sorrowful'.

The eleventh mode is 'inconstant by nature, beautiful, harmonious, magnificent and full of royal majesty'. In Milliet it is 'arranged for tripudiums and dances, and therefore it is called frisky'.

The twelfth mode is 'stern by nature, inconstant and violent. When it becomes more intense it easily rouses into choler. Therefore it is very suitable to warlike subjects that display some kind of fierceness or sternness'. According to Milliet it is 'powerless and mournful, especially suitable for expressing affects of love'. Add to this what Kircher has in book 8, page 51 and page 142.

Thesis 100.

We wanted to present this on the power and efficacy of the modes for exciting our affects from Kircher himself and from Milliet or Gassendi, since these number among the contemporary philosophers, and are indeed by far

scientiam et artem Musicam tradiderunt longe clarissimi. Quibus addi poterit Mersennus, *tractatus Gallicus harmoniae universalis*, lib. I, Theor. 29, nec non ejus *Commentarius in Genesin* et quid in Cap. 4, versic. 21. Quod autem tanta sit tam inter veteres quam modernos in hisce discrepantia, causam dicit Kircherus, *Musurgia*, lib. 7, pag. 555, *non esse aliam nisi complexionum diversitatem, qua fit, ut Tonus, qui uni jucundus, alteri diversi temperamenti luctuosus videatur.*

Thesis CI.

Quod complexionum diversitas, una cum reliquis causis, quas supra enumeravimus, in hominibus valeat hanc perceptionum varietatem, tam ex eadem quam ex diversis Cantilenis in nobis producere, facile concedimus, satis gnari *omne quod recipitur ad modum recipientis recipi*, ideoque, quia *nihil debet esse in iudicio quod prius non fuit in perceptione*, unum hominem de alterius perceptione sensuali stricte nunquam judicare posse, habita tamen et relatione ad cujusvis perceptionem propriam, non posse non eodem modo in hisce ac in omnibus aliis varia hinc sequi hominum iudicia. Sed est certe haec causa magis generalis quam ut nobis in hoc negotio satisfacere queat. Non enim hic de perceptionum varietate, quae prorsus indefinita est, nec quare cum tali motu in organo talis naturaliter conjuncta sit perceptio in anima, quod ingenio humano prorsus indemonstrabile est, tam quaeritur, quam de causa illa, quae absolute et in se considerata motuum illorum varietatem in medio et organo producere solet. Valet autem ratio illa Kircheri de omnibus et singulis Modis, quoad omnes et singulas Cantilenas, in respectu ad omnes et singulos in universum homines. Possunt enim variae Cantilena in eodem Modo diversos effectus, et e contrario eadem Cantilena in diversis Modis eundem effectum et apud eundem et diversos homines producere, ut in sequentibus ulterius demonstrabimus. Non majori ergo ratione videtur haec varietas Modis esse tribuenda, quam quod solent Astrologi in arte sua iudiciaria varia tribuere hominibus temperamenta aliasque qualitates secundum motum apparentem Solis per 12 signa Zodiaci. Haec enim nobis in eodem merito sunt Praedicamento.

Thesis CII.

Quod denique valeat Musica, secundum indefinitam suam varietatem, hos tales effectus, quos ex Kircheri et Milliet adduximus, et fortassis multos alios non tantum in nostris, sed et, caeteris positis, in corporibus reliquis proferre, ultro etiam concedimus. Sed illud omne fere ex varia tonorum ac sonorum inter sese collocatione, mutua successione, combinatione ac temporum mensura, Cadentiarum situ ac sede,

the most famous among those who have handed down the science and art of music to us. To these can be added Mersenne's French *Traité de l'harmonie universelle*, book 1, theorem 29, as well as his *Commentarius in Genesin*, and what he says in chapter 4, versicle 21. Kircher in *Musurgia*, book 7, page 555, says that the reason why there is such a great discrepancy between the ancients and the contemporaries in these matters 'is none other than the diversity of complexions, whereby it is that a tone that is delightful to one seems sorrowful to another of a different temperament'.

Thesis 101.

That the diversity of complexions in human beings, together with the other factors that we enumerated above, has the power to produce this variety of perceptions in us, both from the same and from different songs, we easily agree with, very well knowing that 'everything that is received is received in the manner of the receiver', and therefore, since 'nothing should be under judgment, which has not first been under perception', that one man can never make judgments about the sensual perception of another with exactitude, but considering the relation to everyone's own perception, people's different judgments cannot but follow hereby in the same way in these as in all other matters. But this factor is certainly so general that it cannot satisfy us in these considerations. For our intention here is not so much to investigate the variety of perceptions, which is completely unlimited, nor why a perception in the soul is so naturally connected to such a motion in the organ – this is quite impossible to prove for the human mind – as the cause that separately and considered in itself usually produces the variety of these motions in the medium and the organ. The principle of Kircher applies to each and every mode, as regards each and every song, and with respect to each and every man without exception. For different songs can produce different effects in the same mode, and on the contrary the same song can produce the same effect in different modes, both in the same man and in different men, as we shall show further in the following. It seems as if this variety should be attributed to the modes for no greater reason, than why the astrologers in their judicial discipline usually attribute different temperaments and other qualities to people in accordance with the visible motion of the sun along the twelve signs of the zodiac. For to us these are a category in the same right.

Thesis 102.

That music finally, in accordance with its endless variety, has the power to produce such effects that we adduced from Kircher and Milliet, and perhaps many other ones, not only in our bodies, but also, when the other conditions have been posited, in other bodies, we also concede on our part. But we think that almost all of this comes about from the varying arrangement of tones and sounds in relation to each other, from their mutual successions,

et denique variis Musici artificiis aliis in variis vocibus ac Instrumentis, aliisque specialibus causis, oriri putamus. In quibus omnibus, et forsant multis aliis, quae facile enumerari nequeunt, tantam demonstrat Kircherus, lib. 8 *Musurgiae*, dari posse varietatem, ut in voce 22 notarum tanta sit mutationum varietas, *ut si quispiam singulis diebus mutationum earundem tantum mille scriberet, is in describendo laboraturus sit 22 260 896 143 annis. Unde etiam patet quam inconceptibilis mutationum multitudo ex Motetta quapiam subinde 50, 100, 200, notis constante emanare possit. Certe si tota mundana machina charta repleretur, illa non sufficeret ad omnes mutationes continendas vel in 30 notarum combinatione. Imo, Combinatio haec etiamsi 1 000 annis laboraretur a 10 000 scriptoribus, exauriri tamen non posset.* Et lib. 8, pag. 48: *Si omnes scriptores totius Mundi ab orbe condito semper hujusmodi harmonicarum combinationum descriptioni incubuissent, necdum tamen eas exhausissent.* Et secundum Mersenne, lib. 7 *Harmoniae*, prop. 15: *varietas 22 temporum et notarum major est, quam ut totus Mundus in papyrus conversus illam capere possit.* Hinc mirum nulli videbitur, quod nulla in Musicis melodia alii prorsus similis adhuc inventa fuit.

Thesis CIII.

Quod spectat ad Tactum seu temporis mensuram, ut dictum modo fuit, quantumque illa, vel sola, in musicis praestare possit, idipsum ex tympanis bellicis (vulgo *pukor / trummor*), ubi ad nihil aliud quam ad variam illam temporis mensuram attendimus, omnium optime unicuique constare poterit. Est enim ille Tactus omnibus adeo naturalis, ut Musicus ipse in praxi sua occupatus et aliis causis non impeditus, non possit non illum et pedibus et manibus, imo toto interdum corpore secundum variam, ut vocant, battutam exprimere. Hoc ipsi ante omnes satis confirmant, qui Chelyn vulgarem (vulgo *Nyckelgijga*) pulsare solent. Et haec etiam est ratio, quare non tantum homines in saltationibus omnibus necessum praecipue habeant ad Tactum attendere, sed etiam quod homines surdi, imo bruta ipsa, ad Tactus mensuram saltare possint.

Thesis CIV.

Quomodo cum hisce omnibus Physice comparatum sit, et unde ac quare hi tales effectus ex talibus causis proveniant, nostrum quidem esset jam demonstrare. Sed quia haec omnia hac ratione Dissertationis modum excederent, impraesentiarum de *Modis* praecipue agere constituimus. Reliqua alio occasioni reservamus.

from the combinations and measures of times, from the places and positions of the cadences, and finally from the various different skills of the musician in different voices and instruments, and from other particular factors. In all of these, and perhaps in many others, which cannot easily be enumerated, Kircher shows, in book 8 of the *Musurgia*, that there can be such a great variety, that in a part of 22 notes there is such a great variety of alterations, ‘that if anyone each and every day would write down only thousand of these alterations, he would have to work during 22 260 896 143 years in writing them out. Thereby it is also evident how inconceivable the multitude of alterations can become from some motets, which now and again consist of 50, 100 or 200 notes. Surely, if the whole fabric of the universe should be filled with paper, this would not be sufficient for containing all alterations even in the combination of only 30 notes’. No, ‘even if this combination would be worked on for 1 000 years by 10 000 writers, it could not be brought to an end’. And in book 8, page 48: ‘if all the writers of the whole world from the creation of the Earth had always struggled to write down harmonic combinations of this kind, they would still not have brought them to an completion’. And according to Mersenne, book 7 of the *Harmonia*, prop 15: ‘a variety of 22 durations and notes is so great that the whole world turned into paper would not be able to contain it’. Therefore it should not seem strange to anyone that no melody in music has yet been found that is quite similar to another one.

Thesis 103.

As regards the *tactus* or the measure of time, as was recently mentioned, and how much this, even alone, can bring about in music, this very thing can best of all become evident to everyone from war-drums (in the vernacular *pukor*, *trummor*), where we pay attention to nothing else than the varying measure of time. For the *tactus* is so natural to all, that the musician that is engaged in his practice and not impeded by other factors, cannot but express this both with feet and hands, yes sometimes with his entire body in accordance with the varying *battuta*, as they call it. Above all, this is confirmed enough by those, who usually play the keyed fiddle (in the vernacular *Nyckelgijga*). And this is also the reason, not only why people think it is especially necessary to pay attention to the *tactus* in dances of all kinds, but also that deaf people, yes even animals, can dance to the measure of the *tactus*.

Thesis 104.

How it is arranged physically with all these things, and whereby and why such effects are produced from such causes, would admittedly be our task to explain now. But since all of this would exceed the scope of the dissertation with this method, we have decided to deal especially with the modes for the moment. We shall save the rest for a another occasion.

Thesis CV.

Quandoquidem nonnulli ex hisce *Modis*, juxta variam tertiae ac sextae majoris et minoris collocationem, incedunt per B durum, ut *Modus* quintus in F, septimus in G, undecimus in C, alii vero per B molle, ut *Modus* primus in D, tertius in E, et nonus in A, idcirco in duplici sunt differentia.

Thesis CVI.

Ex hac Modorum diversitate in antecessum concedimus illas ipsas Cantilenas, quae per B molle dispositae sunt, quantum in ipsis est, et caeteris positis, fere semper ad tristitiam, *Melancholiam*, pietatem ac devotionem, aliosque tales affectus, qui spiritus magis crassos et languidos supponunt vel efficiunt, nos commovere. Et contra *Modos* reliquos in B dur, quantum in ipsis est, et caeteris positis, fere semper ad hilaritatem, jucunditatem, gravitatem aliosque tales affectus, qui spiritus magis vegetos ac concitados postulant vel producant, nos animosque nostros excitare. Hoc satis etiam observare noverunt in suis Cantilenis et operibus Musicis Practici tantum non omnes. Hanc itaque Modorum discrepantiam, quatenus ad vires illorum in affectibus nostris respicimus, ultro statuimus. Nam inter Ditonum et Semiditonum, seu inter tonum et semitonium, tanta et unicuique tam sensibilis est differentia, ut non possit non illa diversos et sensibiles in nostris spiritibus excitare motus, et per consequens, et caeteris positis, alias animi producere commotiones.

Thesis CVII.

Hanc etiam ob causam Psalmis illis ex nostris Ecclesiasticis, qui animum magis devotum, moestum ac poenitentia commotum requirunt, *Melodias* hisce *Modis* in B moll respondentes bene atque apposite Antiqui applicarunt, ut sunt:

*På tigh hoppas iag o Herre kiär.
Beklaga aff alt mitt sinne.
O Menniskia will tu betenkia.*

Sicut et illi qui ad *Modum* Phrygium spectant, ut:

*Medhan man lefwer i werlden säll.
Gudh står i Gudz församblingh.
Aff diupsens nödh ropar iagh till tigh.*

aliique perplurimi. Quamvis et hic notandum ipsum vulgus in Ecclesiis nostris cadentias illas in E per F tanquam minus naturales corrigere solere,

Thesis 105.

Since indeed many of these modes, depending on the varying position of the major and minor third and sixth, proceed by the B *durum*, for example the fifth mode in F, the seventh in G, the eleventh in C, but others by the B *molle*, for example the first mode in D, the third in E and the ninth in A, the difference between them is of two kinds.

Thesis 106.

From this diversity of modes we concede beforehand that those songs that are arranged by B *molle*, as far as their nature allows, and when the other conditions have been posited, move us almost always to sadness, melancholy, piety and devotedness, and other affects of this kind, which presuppose or bring about more dull and sluggish spirits. And on the contrary we concede that the other modes in B *durum*, as far as their nature allows, and when the other conditions have been posited, almost always excite us and our minds to cheerfulness, delight, gravity and other affects of this kind, which require or produce more vigorous and excited spirits. Almost all practicians are also careful enough to observe this in their songs and musical works. Therefore we on our part establish this discrepancy between the modes, as far as we consider their power upon our affects. For between the ditone and the semiditone, or between the tone and the semitone, there is a difference that is so great and so perceivable for everyone, that it cannot but excite different perceivable motions in our spirits, and as a consequence, when the other conditions have been posited, produce different commotions of the mind.

Thesis 107.

For this reason the ancients also well and suitably applied melodies that corresponded to the modes in B *molle* to those of our hymns in the church, which call for a mind that is more devout, sorrowful and affected by repentance, for example:

*På tigh hoppas iag o Herre kiär.
Beklaga aff alt mitt sinne.
O Menniskia will tu betenkia.*

As well as the ones that concern the Phrygian mode, for example:

*Medhan man lefwer i werlden säll.
Gudh står i Gudz församblingh.
Aff diupsens nödh ropar iagh till tigh.*

and many others. It should, however, also be noticed here that the common people themselves in our churches usually correct the cadences at E through

et loco F substituere Fis, ut unusquisque de facto observare poterit. Sicut et in Musica recentiorum necdum invenire licuit Melodiam vel Motettam in E, in qua non sit Fis stricte notatum.

Contra vero Psalmi illi, qui animum ostendunt vividum, erectum et sibi acquiescentem, reliquis Modis in B dur, caeteris positis, rectius accommodati sunt, ut:

*Min Siähl skall lofwa HErren.
Hwar man må nu wähl glädia sigh.
Sig fröjde nu Himmel och Jordh.*

et caeteri ejusdem ordinis.

Thesis CIIX.

Hac ratione contendimus jam Modos 1, 3 et 9, et Modos 5, 7, 11, quantum in ipsis sit, et caeteris positis, ejusdem esse efficaciae ad animos hominum commovendos. Quod autem ad Modos secundarios pertinet, qui habent quintam superius et quartam inferius, ut 2, 4, 6, 8, 10, 12, eadem videtur eorum esse ratio ac est Primariorum, cum eadem sint illorum cadentiae, eademque tonorum ac semitoniorum inter sese collocatio.

CIX.

Diximus autem Modos illos *quantum in ipsis sit et caeteris positis* hoc efficere posse, quia nec hoc in ipsis perpetuum est, quin habita ratione ad caeteras circumstantias, quarum in superioribus facta fuit mentio, nec non ad varietatem animi hos motus in se recipientis, hoc idem innumeris modis variari possit. Sic nec omnes Melodiae in B dur laetitiam, nec omnes in B moll tristitiam inducunt, quod experientia ipsa satis confirmat. Psalmi enim illi:

*O Gudh hwem skall iag klaga, then sorgh.
O Jesu Christ san Gudh och Man (ut hic Upsaliae canitur).
Wijdh the Elffwer i Babylon.*

et alii bene multi per B dur canuntur, et tamen quoad Melodiam aequae moestitiam inducere videntur ac ulli fortassis alii. Ita e contrario:

*Till tigh aff hiertans grunde.
Från Gudh will iag ey skillias.
JEsus är mitt lifff och hälsa.*

F as being less natural, and substitute the F with an F sharp, as everyone can observe in reality. Likewise it has not yet been possible to find a melody or a motet in E in the music of our contemporaries, in which the F sharp is not accurately marked out.

But on the other hand the hymns that display a spirit that is lively, animated and satisfied with itself are, when the other conditions have been posited, more properly suited to the remaining modes in B *durum*, for example:

*Min Siähl skall lofwa HErren.
Hwar man må nu wähl glädia sigh.
Sig frögde nu Himmel och Jordh.*

and others of the same kind.

Thesis 108.

For this reason we contend that the modes 1, 3 and 9, and the modes 5, 7, 11, as far as their nature allows, and when the other conditions have been posited, have the same efficacy for stirring the minds of men. As regards the secondary modes, which comprise the fifth above and the fourth below, as 2, 4, 6, 8, 10, 12, their principle seems to be the same as the one of the primaries, since their cadences are the same, and the arrangement of tones and semitones is the same in relation to each other.

Thesis 109.

However, we said that the modes can have this effect ‘as far as their nature allows, and when the other conditions have been posited’, since neither is this always true in them, that this effect cannot vary in uncountable ways, with consideration taken to the other circumstances that were mentioned above, but also to the variety of the mind that receives these motions in itself. Therefore neither do all melodies in B *durum* induce happiness, nor do all in B *molle* induce sadness, which experience itself confirms enough. For the hymns:

*O Gudh hwem skall iag klaga, then sorgh.
O JEsu Christ san Gudh och Man (as we sing it here in Uppsala).
Wijdh the Elffwer i Babylon.*

and very many others are sung along B *durum*, and still, as far as the melody is concerned, they seem to induce sadness equally much as some others perhaps do. Thus on the contrary:

*Till tigh aff hiertans grunde.
Från Gudh will iag ey skillias.
JEsus är mitt lifff och hälsa.*

B moll sonant, quum tamen nihil minus quam tristitiam inferre videantur.

Imo perplurimae sunt Cantilenae, in quibus sola temporis mensura hanc varietatem efficere videtur, ut:

Alt hwadh wij å Jorden äga.

Waka up aff synden tu Christendomb.

Mig gör stoor lust och glädie.

Ad quod etiam semper vel attendunt vel attendere debent Musici Practici. Hinc itaque vel maxime constat hanc affectuum varietatem non ex Modis Musicis, sed ex aliis omnino causis, quae longe plurimae sunt, provenire.

Thesis CX.

Maximum vero a parte contraria videtur esse Argumentum ex differentia tonorum in scala Musica, eorumque varia inter sese collocatione ac successione. Ut si Cantilena sit in C dur, sitque inter C et D tonus minor, erit inter D et E tonus major in secundo loco. Si vero sit Cantilena in B dur, sitque inter B et C tonus major, fiet inter C et D tonus minor in loco secundo, et ita in reliquis. Quae differentia aliquam apud nos varietatem efficere posse videtur. Sed respondemus hanc differentiam inter tonum majorem et minorem sensibus nostris practice esse prorsus insensibilem, ideoque et hic considerationem non mereri. Est enim, secundum jam dicta, tonus major ut 9 ad 8, et tonus minor ut 10 ad 9, quorum differentia est Comma, aliis schisma, ut 81 ad 80. Quis autem practice auribus percipere queat num nervus vel chorda faciat vibrationes 81 aut 80, id certe libenter experiri vellem.

Thesis CXI.

Inter Musica Instrumenta usitatissimum et omnibus fere occasionibus maxime accomodatum esse videtur Violinum, seu Chelys minor. Quousque igitur haec differentia sensibilis sit, ut melius unicuique pateat, consideret Schema appositum in thesi 97, ubi secundum divisionem Harmonicam spatium illud minutissimum inter *K* et *L* exprimit nobis intervallum inter tonum majorem et minorem, quae differentia tam exigua est, ut vel auribus discerni vel practice observari vix queat. Hoc multis modis probari potest. Contendunt Musici Theoretici eam in Praxi industriam adhibendam esse, ut illi toni majores et minores pro varia ad invicem collocatione sedem suam mutant, *ut semitonium majus necessario habeat utrimque juxta se tonum*

sound the B *molle*, although they still seem to bring about nothing less than sadness.

Yes there are very many songs, in which the measure of time alone seems to produce this variety, for example:

*Alt hwadh wij å Jorden äga.
Waka up aff synden tu Christendomb.
Mig gör stoor lust och glädie.*

To this musical practitioners also always pay attention or should pay attention. Hereby it is thus as evident as possible that this variety of affects does not originate from the musical modes, but from completely different factors, which are very many.

Thesis 110.

But the most important argument from the contrary side seems to be from the differences of the tones in the musical scale, and their varying positions and successions in relation to each other. If, for instance, the song is in C *durum*, and there is a minor tone between C and D, there is a major tone between D and E in the second place. But if the song is in B^b *durum*, and there is a major tone between B^b and C, there is a minor tone between C and D in the second place, and likewise in the remaining ones. As it seems, this difference can produce some kind of variety in us. But we answer that this difference between the major and minor tone is quite inconceivable to our senses in practice, and therefore it does not deserve consideration also here. For in accordance with the already mentioned, the major tone is as 9 to 8, and the minor tone as 10 to 9, the difference of which is a Comma, to others a Schisma, as 81 to 80. Who in practice is able to perceive with his ears whether a string or chord produces 81 or 80 vibrations, that I would very much like to experience.

Thesis 111.

Among musical instruments the violin, or the *chelys minor*, seems to be the most commonly used and most suited to almost all occasions. Accordingly, in order for it to be more evident to everyone to what extent this difference is perceivable, one should examine the figure attached in thesis 97, where, according to the harmonic division, the very small space between K and L expresses the interval between the major and minor tone to us. This difference is so small that it can hardly be discerned with the ears or noticed in practice. This can be proved in many ways. The music theorists contend that such diligence should be applied in practice, that the major and minor tones change their places depending on their different positions in relation to each other, 'so that the major semitone necessarily has a major tone next to

majorem, ita et tonus minor, cum quo scilicet hic ditonum componat, et quae sunt reliqua, quae vide apud Cartesium in Compendio Musico, de Gradibus, ita ut tonus major quodammodo mobilis fiat. Unde concludit quod inter 480 et 486 in Fig. 1 (quam schisma vocat, et differentia est inter tonum majorem et minorem) tam exigua sit differentia, ut illius termini, qui ab utroque constituitur, mobilitas non perceptibili dissonantia auditum feriat. Et rursus pag. 27: tam exiguum est schismatis intervallum, ut vix auribus possit discerni. Neque enim Consonantiarum termini ita consistunt in indivisibili, ut si unus ex illis aliquantulum immutetur, statim omnis Consonantiae suavitas pereat. Eodem modo Mersennus, lib. 6, Prop. 7, definit quandonam tonus major inter UT et RE, et minor inter RE et MI collocari debeat, quum non necessarium sit, ut tonus minor vel major in iisdem locis statuatur, sed Musicum, ubicunque voluerit, tonum minorem vel majorem facere posse. Neque enim (Prop. 25), si fecerit tonum majorem ab F ad G, eundem faciet a G ad F, sed minorem. Quod nobis certe hoc in negotio prorsus satisfacit.

Thesis CXII.

Si autem vel maxime ponamus talem tonorum mutationem in majorem et minorem practice fieri posse in vocibus et Instrumentis quoad intervalla Musica indivisis (quod tamen nec concedimus) – qualia sunt variarum specierum Violae – nullo tamen modo hoc observari potest in reliquis omnibus Instrumentis, quae jam ante secundum sua intervalla sunt divisa, ut omnia Instrumenta Pneumatica nobis cognita praeter tubam ductilem. Quibus comprehendimus omnia genera tibiularum, fistularum, cornuum, dulcinarum, tubarum, buccinarum, et omnia Organa et Regalia, item omnes chelijum species majores et ipsae lyrae mendicorum, ut *Nyckelgijga / Långspeel*, ac omnia testudinum et Cijthararum genera, ut et harpas, pandoras etc., et denique omnia Instrumenta polyplectra, ut vocant, et quae Clavaria continent, ut Clavicymbala, Clavichordia, Spinettae, Symphoniae, etc., quum tamen haec posteriora una cum Violis majoribus (vulgo *Baassviol*) semper fundamenti loco in praxi adhiberi soleant, et Bassum Generalem contineant, ad quem voces reliquae omnes et Instrumenta dirigi debeant. Quamvis autem ad Instrumenta illa Polyplectra perficienda plurimae et variae praescribi soleant a Musicis scalae divisiones, ut etiam peculiaris est apud Cartesium, Vol. 3, Epist. XCV, nunquam tamen ad eam perfectionem hoc in negotio practice pervenimus, ut huic difficultati satisfaciat et omnibus scalae divisionibus respondeat.

itself on both sides, just like the minor tone, with which it of course makes up a ditone', and so on, for which see Descartes in *Compendium Musicae*, on the steps, 'so that the major tone becomes mobile in some way'. Thereby he concludes 'that there is such a small difference between 480 and 486 in figure 1' (which he calls *schisma*, and which is the difference between a major and a minor tone), 'that the mobility of this term, which is established by both of them, strikes the hearing with no perceivable dissonance.' And again on page 27: 'the interval of the *schisma* is so small, that it can hardly be discerned by the ears. For neither do the terms of the consonances consist in the indivisible in such a way, that if one of them slightly changes, immediately all sweetness of the consonance perishes'. In the same way Mersenne, in book 6, proposition 7, defines 'when the major tone should be placed between UT and RE, and the minor between RE and MI, since it is not necessary that the minor or major tone is located in the same places, but the musician can bring about a minor or major tone wherever he wants to. For (proposition 25) neither does he bring about the same from G to F, if he brings about a major tone from F to G, but a minor one'. In these considerations this is certainly quite sufficient for us.

Thesis 112.

But if we above all suppose that such an alteration of tones into major and minor can take place in practice in voices and instruments that are undivided as regards their musical intervals (which we however do not concede) – such are the *violae* of different kinds – this still cannot be observed in any way in all remaining instruments, which are already beforehand divided according to their intervals, for example all wind instruments that are known to us, with the exception of the sackbut. In these we include all kinds of flutes, pipes, horns, curtals, trumpets, cornetts, and all organs and regals. Likewise all bigger kinds of *chelys* and *lyrae mendicorum*, for example *Nyckelgijga / Långspeel*, and all kinds of lutes and citterns, as well as harps, pandoras, etc., and finally all polyplectrum instruments, as they call them, and those which include keyboards, for example harpsichords, clavichords, spinets, symphonies, etc., although these latter ones are in practice usually always used as the fundament together with the bigger *violae* (in the vernacular *baassviol*), and contain the thoroughbass, by which all other voices and instruments should be directed. But although several different divisions of the scale are usually prescribed by the musicians for the construction of these polyplectrum instruments, which is also especially mentioned in Descartes, vol. 3, letter XCV, we never reach such a perfection in this matter in practice, that it compensates these difficulties and corresponds to all divisions of the scale.

Thesis CXIII.

His addimus quod Auctores nec inter sese conveniant, ubi in scala Musica tonus major vel minor sit collocandus. Kircher Musurgia, l. 3, p. 101, ponit inter CD et inter GA tonum majorem. Lib. 4, p. 178, ponit inter GF tonum minorem. Lib. 7, p. 649, facit inter CD tonum minorem, et DE majorem. Item inter FG tonum majorem, et GA tonum minorem. Rursus inter CD et GA tonum minorem, et DE et FG tonum majorem. Lib. 6, p. 447, supponit inter CD, FG, GA, AH sine discrimine tonum majorem.

Mersennus lib. 6, Prop. 6, collocat a C ad D, nec non a G ad A tonum minorem, a D vero ad E, et a F ad G tonum majorem. In Prop. 8 ponit inter C et D tonum majorem. In Prop. 22 inter C et D statuitur tonus major, inter D et E tonus minor. Quibus adde, si placet, quae habet Prop. 25. Milliet inter hos gradus ponit tonum medium, quem vide Tom. 3, tract. 22, Prop. 11. Si ergo hac ratione Theoretice tanta sit inter Auctores dissentio, quid haec differentia tonorum practice efficere valeat, nemo non intelliget.

CXIV.

*Praeterea si hanc differentiam Physice et Practice in Instrumentis indivisis considerare voluerimus, certe ad eam accurationem vix unquam perveniet etiam Musicus excellentissimus. Habito enim respectu ad vocem humanam, nemo tam exacte spiritus musculosque intendere ac remittere poterit, ut haec differentia requirit. Quod praxis ipsa satis confirmat. Reliqua Instrumenta omnia vix Artifex tam exacte distinguet, vel Musicus tam accurate inflabit aut inter sese nervos vel chordas concordare faciet, ut haec differentia observetur. Quod si autem et hoc concedere vellemus, notum tamen est quam sensibilibus mutabiles sint omnes nervi ac chordae ad aeris mutationes secundum calorem et frigus, humiditatem et siccitatem, ut reliqua omnia nunc omittamus. Hoc etiam agnoscit Milliet, Prop. 34, nempe quod *chordae ex animalium intestinis confectae suum tonum non retinent, atque adeo ad perfectam consonantiam vix unquam adduci possunt, aut saltem non diu perseverant*. Ita Prop. 36: *tanta chordarum aenearum in Clavicymbalis copia non ita facile ad concentum adducitur nec ita firmiter in eo perseverat*. His poterit et illud addi, quam obtusi ac molles sint digiti nostri ad tantam accurationem exprimendam, quibus tamen tonos hosce in Violis minoribus determinare solemus. Et ubi etiam tremuli illi digitorum (vulgo *mordanter*) ad majorem sonorum jucunditatem fieri jubentur, qui tamen non minorem fortassis efficiunt soni differentiam quam est illud Comma.*

Thesis 113.

To this we add that the authors also do not agree with each other on where the major or minor tone should be located in the musical scale. Kircher, in *Musurgia*, book 3, page 101, puts a major tone between CD and between GA. In book 4, page 178, he puts a minor tone between GF. In book 7, page 649, he makes a minor tone between CD, and a major between DE. Likewise a major tone between FG, and a minor tone between GA. Again a minor tone between CD and GA, and a major tone between DE and FG. In book 6, page 447, he assumes that there is without discrimination a major tone between CD, FG, GA and AH.

Mersenne, in book 6, proposition 6, places a minor tone from C to D, as well as from G to A, but from D to E, and from F to G a major tone. In proposition 8 he puts a major tone between C and D. In proposition 22 a major tone is placed between C and D, and a minor tone between D and E. Add to these, if you want, that which he has in proposition 25. Milliet puts a middle tone between these steps, on which see tome 3, treatise 22, proposition 11. Accordingly, if there is in this way such a great disagreement between the authors in theory, everyone shall understand what this difference of tones has the power to bring about in practice.

Thesis 114.

Moreover, if we want to consider this difference from a physical and practical perspective in undivided instruments, surely even the most brilliant musician hardly ever reaches such a precision. For with respect to the human voice, nobody can strain and release the breath and the muscles as exactly as this difference requires. Practice itself confirms this enough. The craftsman hardly distinguishes all the remaining instruments so exactly, or the musician hardly inflates so precisely or makes the strings or chords be in such concord with each other, that this difference is noticed. But if we would like to concede also this, it is nonetheless well-known how perceptibly all strings and chords are liable to changes depending on the changes of air according to heat and cold, humidity and dryness, just to omit mentioning all the rest. Milliet, proposition 34, also acknowledges this, namely that *chords made from the intestines of animals do not retain their tone, and therefore they can hardly ever be brought to a perfect consonance, or at least they do not persist for a long time*. Likewise proposition 36: *such a great amount of chords of bronze in harpsichords is not brought to a concord very easily and does not persist in it very steadfastly*. To these facts this can also be added, how weak and soft our fingers are for expressing such a precision, with which we still usually determine these tones in smaller *violae*. And when even the trembles of the fingers (in the vernacular *mordanter*) are requested to occur for a greater enjoyment of the sounds, they nevertheless produce a difference of sound that perhaps is not smaller than the mentioned comma.

Thesis CXV.

Denique et hoc addimus, quod non omnia Instrumenta Musica ad eundem tonum vel ad concentum illum universalem (vulgo *Chormessig*) semper consonant. Quo fit ut simul et semel ab uno tonus major, ab altero minor exaudiri possit, et ita consequenter, quum tamen hoc Auditoribus insciis fiat, quod nullum exinde discrimen discernere queant.

Thesis CXVI.

Posset adhuc forte quis cum *Mersenno* ex lib. 6, Prop. 26, argumentari nonnulla instrumenta Musica, ut tubam bellicam, cornua aliasque tibias militares, *ad bella referenda, vel ad aliquid generosum atque nobile repraesentandum* ab ipsa natura constructa esse, utpote quae ad Modum Jastium communiter formata sunt. Tubae enim illae bellicae (vulgo *Trumpett*) per CEG tam naturaliter et necessario procedunt, ut vix, praesertim in gravioribus tonis, alios ibi invenias, secundum eas videlicet notulas eamque rationem quam in Disputatione priori, th. 39, demonstravimus. Respondemus vero hunc effectum ex hisce Instrumentis nos concedere, sed illum nec Modo huic Jastio, nec etiam ipsi tubae, quatenus huic tono respondet, esse tribuendum, verum ipsis Cantilenis (vulgo *Trumpetstycken*), quae ea ratione, ut hilaritatem ac animi promptitudinem referant, quam maxime compositae sunt, ut et aliis ipsius soni qualitatibus, praecipue latitudini adscribendum esse, ut unicuique facile constabit. Hoc autem vel exinde patet, quod si tubam illam militarem vel longiorem vel brevioris quis construat, etiam alium reddet sonum priori vel graviorem vel magis acutum, et per consequens alio reipsa *Modo* respondebit. Et tamen haec tuba, caeteris positis, eundem apud nos dabit effectum. Hoc idem fiet si formentur in illa tuba foramina, ut est in fistulis. Hac enim ratione aequivalenter etiam minuitur longitudo tubae, et consequenter magis acutus datur sonus. Clarius adhuc id constabit ex tuba ductili (vulgo *Basun*), quae ut longior quoque vel brevior reddatur etiam sonum quoad profunditatem varium dabit, eadem tamen manente natura Melodiae. Hoc enim ipsimet per Legionis Praetoriae tubicinem satis industrium experti sumus.

Et quid multa, constat Clementissimi Regis tibicines militum praetorianorum non per Modum Jastium in C, sed per Myxo Lydium in G, easdem melodias ac tubicines quotidie canere, quia illorum tibiae minores ad concentum universalem adornatae non sunt, quum tamen eadem fere maneat hujus Musicae vis atque efficacia ac si fieret tubis bellicis.

115.

Finally we also add this, that not all musical instruments always sound in concord with the same tone or with the whole consort (in the vernacular *chormessig*). That is why at one and the same time a major tone can be heard from one and a minor tone from another, and continuing in this way, although it is the case for ignorant listeners, that they cannot discern any discrimination from it.

116.

Someone could perhaps still argue with Mersenne from book 6, proposition 26, that many musical instruments, for example the war trumpet, horns and other military flutes, are construed by nature itself ‘for referring to wars, or for representing something high-born and noble’, since they are generally fashioned into the jastian mode. For these war trumpets (in the vernacular *Trumpett*) proceed so naturally and necessarily through CEG, that you, especially in the lower tones, hardly find any others there, and they certainly do so in accordance with the notes and the principle that we described in the previous disputation, thesis 39. We answer, however, that this effect is granted to us from these instruments, but that it should be attributed neither to the jastian mode, nor even to the trumpet itself, as far as it corresponds to this mode, but to the songs themselves (in the vernacular *Trumpetstycken*), which are for the most part composed in such a way that they bring about cheerfulness and a readiness of mind, and it should also be ascribed to the other qualities of this sound, especially to its volume, which is very evident to each and every one. This is even obvious from the fact that if anyone builds such a military trumpet that is either longer or shorter, it also renders a different sound, which is either lower or higher than the previous one, and as a consequence it corresponds to another mode in reality. And nevertheless this trumpet, when the other conditions have been posited, brings about the same effect in us. The same thing happens if openings are created in this trumpet, as the case is in flutes. For with this method the length of the trumpet is also diminished to an equivalent amount, and as a consequence a higher sound is rendered. This is even more evident from the sackbut (in the vernacular *basun*), which according to whether it is also made longer or shorter produces a sound that varies in pitch as well, while the nature of the melody still remains the same. For we have experienced this ourselves by a very skillful trumpeter of the Royal lifeguard regiment.

And for the rest, it is evident that the flautists of our most merciful King’s lifeguard soldiers everyday play the same melodies as the trumpeters, not in the jastian mode in C, but in the mixolydian in G, since their smaller pipes are not made for a whole consort, while almost the same power and efficacy of this music still remains as if it took place on war trumpets.

Thesis CXVII.

Haec omnia, quae jam de illa differentia inter tonum majorem et minorem a nobis dicta sunt, etiam de illa discrepantia, quae est inter semitonium majus et minus, fere intellectum volumus, ideoque brevitatis causa nunc non repetimus. Ut enim haec demum concludamus, ad unius cujusque experientiam hoc in negotio provocamus, satis certi quod nemo practice possit hanc sonorum differentiam determinare. Imo constat saepe gravissimos a Practicis errores committi, quos tamen Auditores non tantum non animadvertunt, sed ut summum potius artificium interdum reputant. Tales autem effectus, si hinc provenirent, aequè animos vulgi ac Musices periti commoverent. Atque ita nec illam tonorum differentiam aliquem sensibilem in *Modis* diversis effectum et discrepantiam in nobis excitare posse contendimus.

Thesis CXIIX.

Idem etiam ex transpositione Melodiarum per Modos diversos satis manifestum est. Musicis enim Practicis nihil jam usitatus est, quam quod cum eadem Cantilena, si tantum B dur ac B moll observent, per varios, imo per omnes, si ita placeat, Modos successive transeant, manente eadem ejus Cantilena vi atque efficacia. Et quod optime hoc evincere videtur: poterit una et eadem Melodia non tantum successive, sed etiam simul et semel in omnibus Modis cani, modo attendant ad B moll et dur, si modo tot Musici cum Instrumentis commodis adfuerint. Quod per varium nervorum concentum (vulgo *förstämmingh*), praecipue in Violinis, manentibus reliquis nervis et chordis immotis, a Practicis summa cum jucunditate fieri solet. Et ita quidem fieri, ut nemo ex Auditoribus id intelligere, vel qua in clave canatur percipere possit. Haec omnia in ipsa Dissertatione, siquidem aliter fieri non potest, practice ostendere nitemur.

Thesis CXIX.

Ipsè Kircherus, qui alias hisce Modis plus aequo tribuit, hoc idem etiam ultro nobis largitur. *Musurgia* enim, lib. 8, p. 51, Mensam, ut vocat, tonographicam generalem huic transpositioni servientem adducit, quam etiam basin et fundamentum totius Musurgiae suae mirificae statuit, quae ibidem videri poterit. Pag. 62 ostendit quomodo *modus sextus in Primum, Secundum, Tertium et Quartum*, transponi possit. Et denique pag. 63 proponit *Systema universale, quo assumptum thema Musicum per 12 tonos mutari possit essentialiter*. Quo concesso certe ulterius hic quicquam non desideramus.

Thesis 117.

All that we have said about the difference between the major and the minor tone, we more or less want to be understood also as regards the discrepancy that is between the major and minor semitone, and therefore we do not repeat it now, for the sake of brevity. For in order to finally conclude this, we appeal to the experience of each and every one in these matters, being sure enough that nobody can determine this difference of the sounds in practice. Yes it is evident that very grave errors are often committed by practitioners, which listeners still not only do not notice, but once in a while rather consider as the highest artistry. But such effects, if they should arise hereby, would stir the minds of the masses and of the skilled musician to an equal degree. And likewise we contend that this difference of tones cannot rouse any perceivable effect and discrepancy in us in different modes.

Thesis 118.

The same is also obvious enough from the transposition of melodies by different modes. For nothing is more familiar to musical practitioners, than that they with the same song, if only they observe the *B durum* and *B molle*, pass through the different modes step by step, yes through all, if they so wish, while the power and efficacy of this song remains the same. And what seems to demonstrate this very well: one and the same melody can be played not only in succession, but also at one and the same time in all modes, provided that they pay attention to the *B molle* and *durum*, if only so many musicians are present with the appropriate instruments. This usually happens with greatest delight by the practitioners by the scordatura (in the vernacular *förstämmingh*), especially in violins, while the other strings and chords remain untouched. And it happens in such a way indeed, that none of the listeners can understand it, or perceive in what key it is played. All of this we strive to demonstrate in practice in this dissertation, since it cannot be done in any other way.

Thesis 119.

Kircher himself, who has otherwise attributed more than is reasonable to these modes, bestows this same thing to us also for his part. For in the *Musurgia*, book 8, page 51, he adduces a general tonographic table, as he calls it, to be employed for this transposition. He also settles that it is the base and foundation of his whole wonderful *Musurgia*, which can be seen in the same place. On page 62 he shows how 'the sixth mode' can be transposed 'to the first, second, third and fourth'. And finally on page 63 he proposes 'a universal system in which a musical theme taken up can be essentially changed by the twelve tones'. Having conceded this we certainly do not desire anything further here.

Thesis CXX.

Haec adducit Kircherus ad artificium suum a se inventum per Arcam (ut vocat) Musarithmicam extollendum, quo majorem in modum probare nititur, quod Arcae hujus ope *quivis etiam quantumvis Musicae imperitus, imo ipsi pueri et mulieres, ad tam perfectam componendi notitiam brevi tempore et sine labore pertingere possint, quantam Practici compositores vix multorum annorum spatio consequuntur. Atque ita secundum Tabellas ejus Melotacticas in quocunque Tono, et quibusvis verborum textibus datis, quascunque artificiosas Cantilenas: simplices, compositas, floridas, diminutas, syncopatas, artificiosis ligaturis intextas, fugarumque in modum sese insectantes ad omnem harmonices venustatem et gratiam, componere queant.* Hujus Arcae Musarithmicae mechanice constructae, pro summa sua in me benevolentia, copiam mihi fecit Nobilissimus atque Consultissimus Dominus Daniel Cameen, Holmensium Consul gravissimus. Quousque autem Kircherus hoc suo arcano Musicis satisfaciat hac vice non disputo, sed aliis dijudicandum relinquo. Quia tamen hac arte nec ultra ciphras in pinnulis notatas progredi, nec unquam Melodiam (ut reliqua nunc taceam) praesupponere liceat, vereor ne plus hic apud Kircherum *sit in judicio quam fuit in perceptione.*

Thesis CXXI.

Hisce ita positis, regeri iterum forsitan posset Modos hosce alios in nobis motus excitare secundum variam suam profunditatem, quatenus tonus quo gravior, eo etiam mollior ac remissior, atque in vibrationibus et motibus tardior sit, ideoque alios etiam affectus producere possit. Sed animadvertendum est nullam Cantilenam ita in uno coarctari tono, ut reliquos excludat, praecipue si ad varias attendamus voces. Deinde si aliqua hic subesset differentia, illa saepissime per Octavae multiplicationem tollitur, ut ex variis vocibus, Tenore et Cantu, nec non Basso, Bassetto et Alto clarissime constat. Huic enim rei tales potius tribuerem effectus, quia longe major inde oritur tonorum inter sese distantia quam unquam ex Modis. Praeterea nec omnia Instrumenta Musica in eodem tono semper concordant, nec cum concentu illo universali consonant. Unde etiam omnis haec varietas, si quae exinde esset, prorsus tolleretur. Et denique recurrimus hic, ut in superioribus, ad ipsam experientiam exploraturi quisnam ex hac tonorum varietate, caeteris remotis, aliquam in se diversitatem sentire queat.

Thesis 120.

Kircher adduces this in order to speak highly of the work of art invented by him with the musarithmetic box (as he calls it), by which he strives to prove in a greater manner, that with the aid of this box ‘even anyone that is inexperienced in music to any degree, yes even boys and women, can attain such a perfect knowledge of composing in a short time and without labour, as practicing composers hardly achieve in the space of many years. And thus they can compose all kinds of artful songs in accordance with his melotactic tables in any mode whatsoever and with any given texts: monophonic ones, polyphonic, florid, figurate, syncopated, ones that are interwoven with artful ligatures and pursuing themselves as a canon to all the grace and charm of harmony.’ The most noble and learned man Daniel Caméen, most respected chief magistrate in Stockholm, in his great benevolence towards me made a copy of this musarithmetic box built in a mechanical way. To what extent Kircher pleases the musicians with his arcane matters I do not debate at this occasion, but I leave it to be decided by others. But since it is neither allowed in this device to proceed beyond the numerals that are inscribed on the small sticks, nor ever to presuppose a melody (just to be silent about the other things now), I am afraid that here in Kircher more ‘is under judgment than there was under perception’.

Thesis 121.

When these matters have been posited in this way, it could perhaps be repeated again that the modes excite different motions in us according to their different pitch, since the lower a tone is, the softer and weaker it is as well, and it is slower in its vibrations and motions, and therefore it can also produce different affects. But it should be noticed that no song is confined to one tone in such a way, that it excludes the others, especially if we direct the attention to different voices. Moreover, if there is any difference at hand here, it is very often removed with a multiplication of the octave, which is perfectly evident from the different voices, tenor and soprano, but also bass, bassett and alto. For I would rather attribute such effects to this fact, since a much greater distance of the tones in relation to each other comes about thereby than ever from the modes. Moreover, neither are all musical instruments always in concord in the same tone, nor are they consonant with the whole consort. That is also why this entire variety would be completely removed, if there was any for that reason. And finally we here, just as above, return to experience itself, in order to find out who is able to feel any diversity in himself from this variety of tones, when the rest has been removed.

Thesis CXXII.

Concludimus itaque, secundum ea quae jam allata sunt, esse quidem maximam *Musices* in animis hominum commovendi varietatem atque efficaciam, sed illam aliis causis a *Modis* longe diversis, ut in sequentibus patebit, omnino adscribendam esse censemus.

Corollarii loco Dominis Musicis nostris Problema sequens animi causa solvendum proponimus.

Data qualibet Cantilena, quibuslibet notulis Musicis expressa, potest illa tam in Tactu Spondaico quam Trochaico designari omnibus et singulis numeris, qui unquam in Triplis significandis adhiberi solent, manente numero eadem Cantilena cum omnibus suis notulis reliquisque qualitatibus. Isti autem numeri sunt 1, 2, 3, 4, 6, 8, 9, 12, 16. Quaeritur jam horum numerorum collocatio, ut hoc obtineatur?

We thus conclude, in accordance with that which has now been presented, that the variety and efficacy of music in exciting the minds of men is admittedly very great, but we think that it should in general be ascribed to other factors, which are very different from the modes, as shall be evident in the following.

Instead of a corollary we set out the following problem to be solved by our musicians, for their own gratification.

Given a song of any kind, expressed in musical notes of any kind, this can as well in the spondaic *tactus* as in the trochaic be marked out with each and every number that is ever usually adopted for signifying triples, while the song still remains the same in number with all its notes and other qualities. These numbers are 1, 2, 3, 4, 6, 8, 9, 12, 16. Do we now have to know the positions of the numbers for this to be achieved?

3.2 Structure and Contents

Title

Dedication

Theses

84–90: Music and the affects.

84–87: Reference to and quotation from the last thesis of the earlier dissertation *De sono*. All know from experience that music excites the affects. Philosophers reflect upon why.

88–90: Mostly these philosophers attribute music's power to the musical modes, which are explained briefly. Their number and names are related.

91–97: The musical intervals. The division of strings.

91–92: Two kinds of harmonic divisions of a string into intervals: in relation to itself, or with respect to the mutual relations of intervals and consonances. The proportions of the musical intervals are accounted for in root numbers.

93–96: The primary intervals are illustrated in the division of a string with the later method. From the intervals and the steps in the scale the twelve modes are deduced. Intervals according to the numbers given in thesis 92 are illustrated in the division of a string.

97: The division of the string according to the former method.

98–109: The modes and the affects.

98–100: Back to the influence of modes on human minds. Musical authors disagree. The view of Kircher that the affects that are connected to each mode is compared with that of Milliet Dechaies. References to further authors.

101–104: Perception is endlessly diverse in people, and therefore judgments are similarly varied. Also music, due to tones, times, cadences, etc., is endlessly diverse. The impact of *tactus* on the listeners is stated. A physical investigation of these facts is omitted here.

105–109: Modes. Some proceed through B *molle*, and create sadness, other through B *durum* and create delight (but not always). The ancients knew this. Examples from Swedish hymns. The efficacy of moving the minds of men is the same in the secondary as in the primary modes. Time is likewise influential. The variety of affects thus does not depend on the modes.

110–120: Modes do not rouse affects.

110–115: The difference of tones, their positions and successions. The importance in practice of the comma (or schisma), i.e. the difference between a major and a minor tone, is questioned.

116–120: Changes of modes do not alter affects, rather it is the songs themselves, and their volume, among other things. Transpositions of songs into other modes support this. References to Kircher; his tonographic table and musarithmical box are mentioned.

121–122: Music's power to rouse affects should be ascribed to factors other than the modes, to pitch among other things.

Corollary

3.3 Commentary

Title:

Secunda] The word establishes the link to the previous dissertation *De sono*, and shows that this was meant as a continuation of that work. See also the commentary on the title page of *De sono*, as regards the customary information on title pages of dissertations.

NATHANAELE RYDELIO] Nathanael Israelis Rydelius was born in Hällestad in Östergötland in 1662 as the son of a clergyman, who died in 1669. He matriculated at Uppsala University on 13 October 1680 (*Uppsala Universitets matrikel*, vol. 1, p. 268), where he was certainly a member of the same student nation as Vallerius, and defended this dissertation *De modis* on 24 April 1686. Later the same year he was granted a musical scholarship at the university (*Akademiska konsistoriets protokoll*, vol. XVIII, pp. 111, 178 and 256). In 1688 he became *director cantus* in Linköping, and he died in 1693, having been appointed *conrector* of the school there the same year (Odén 1902, p. 85). Extant archival material from Linköping cathedral displays appreciative words on his skill and character (Luttu 1968, p. 30).

After Nathanael's father had died in 1669, his widowed mother married Harald Vallerius's five years elder brother Johan, and in 1690 Nathanael himself married Christina Vallerius, the daughter of Harald Vallerius's elder brother Nils, who was 18 years older than Harald (*Svenska ättartal* 1892, pp. 463 ff.). Nathanael was thus both the stepson of one of Harald's brothers and the husband of one of Harald's nieces.

In Regiae Upsaliensis Academiae ... horis ante meridiem consuetis] On the occasion of the dissertation's defence Vallerius apparently illustrated the impact of music on the affects with live music. Upmarck in his funeral oration relates that Vallerius then made an experiment into the wonderful power of different musical modes on the affects, with the aid of his choir

and a musical ensemble. He gave instructions to always strike the strings in different ways and to sing a diversified tune that appeared to be like an incantation, rendering the audience now happy, now depressed by sorrow, now excited with anger, and that finally struck them with fear, as if they were under enemy attack (Upmarck 1729, pp. 122 f.):

Meminimus, cum ... in experimentum mirabilis imperii, quod in affectus humanos modorum Musicorum diversitas obtinet, occasione disquisitionis Academicae, choro ille suo, omni symphoniaca supellectile instructo imperaret alia aliaque ratione nervos impellere et diversum interjectis vicibus melos concinere, visum praestigiis simile et incantamentis, quod nunc laetitiam animis infunderet, nunc auditorum turbam omnem inopino dolore dejiceret, nunc ira accenderet, rursus metum ac formidinem, qualis incessere imminente hoste solet, incuteret.

Upmarck is evidently relating a story that was well remembered from this occasion, although he cannot have accounted for things absolutely correctly. Vallerius in the dissertation specifically contradicts the idea that the power of music on the affects depends only on the musical modes, so his demonstration must rather have stressed the several different important aspects that give music its power. Nevertheless it proves that oral disputation could be complemented by practical performances of other kinds.

subjicit] Notice that the grammatical subject is still Harald Vallerius, just as in the first dissertation *De sono*, although he here fulfils the duty of the praeses. The implication of this circumstance for the question of authorship is discussed in section 1.4 above.

Henricus Curio] Henrik Curio was born in Erfurt in 1630. He was employed by the book printer Johan Janssonius the elder in Amsterdam from 1643, and was the manager of Janssonius's printing shop in Stockholm and Uppsala between 1648 and 1660. In 1656 he was granted the privilege to be the bookseller of Uppsala university on behalf of Janssonius, and in 1661 a Royal privilege as the bookseller and printer of the university on his own. Due to economical misconduct, and books printed with hopelessly worn-out types, he was condemned to lose his position in 1675, although the judgment was not finally confirmed until ten years later. In the meantime Curio had continued working as before. In 1685 he thus became the printer of Olof Rudbeck, and two years later he was allowed to assist the ordinary printer of the university. He died at the beginning of 1691 (Klemming & Nordin 1983, pp. 183 ff., and *SBL*, s.v. *Curio, Henrik*). Considering the date of the disputation, we can thus conclude that the words of the imprint are not strictly correct at this time.

Dedication:

Interestingly, this dedication cannot be found in all the extant copies of the *De modis*-dissertation. In the copy stored at Uppsala University Library we find it printed on the verso of the title leaf. In the copies stored at the Royal Library of Stockholm, Lund University Library, Gothenburg University Library and Södertörn University Library there is no printed text at all on that page. In the copy stored at the Diocese Library of Linköping, however, another dedication has been printed on the verso of the title leaf and on the recto of the following leaf. There we find a piece in lapidary style directed to four important clergymen in the diocese of Linköping, Rydelius's native region, where he returned after the studies in Uppsala. Among the dedicatees is the stepfather Johan Vallerius.

VIRO. ...] The dedication is written in the lapidary style that was so popular in occasional literature at the time. The words are thus not only arranged on the page in a manner typical of inscriptions, but all of them are also separated by dots, which are here thus to be understood not as interpunctuation, but as an indication of genre. However, as has been asserted by Per S. Ridderstad, who has treated the genre at length, in the latter half of the 17th century in Sweden dedications in this style can almost exclusively be found in the academic contexts of Uppsala, and a major part of them occur in dissertations (Ridderstad 1975, p. 276).

JOANNI. MARKER.] Johan Marker was born in Långbro in Närke in 1628 as the son of a lay assessor (*nämndeman*). He became registrar in the Royal chancellery, and in that position formed part of the field chancellery during the war against Poland and the Denmark in the 1650s, and Denmark in the 1670s. Due to a severe illness during the latter, he had to return to Stockholm, and he was granted a Royal letter in 1677 assuring him the position of assessor and counsellor (*rådman*) in the town, as soon as one became vacant. He died in Stockholm in 1708 (Munthe 1935, p. 131; *Stockholms rådhus och råd* 1915, p. 191). Three of Johan Marker's sons matriculated at the philosophical faculty of Uppsala university in 1679. One of them, Nicolaus Johannis Marker, gave a funeral speech on Magnus Gabriel De la Gardie in Uppsala in 1686 (Thimon 1982, pp. 156 f.). Accordingly the sons were all student fellows of Nathanael Rydelius, and this fact could conceivably explain the connection between him and the dedicatee.

Senatus. Holmensis.] The word *senatus* can often refer to town councils at this time, just as it does here (cf. Helander 2004, p. 210).

Conamina. qualiacunque. mea.] The dedication is undersigned by Nathanael Rydelius, so these words are clearly to be understood as his own. But the information on his own efforts is vague. Considering what was said in section 1.4 on the question of authorship above, there are no real reasons for us to believe that *conamina mea* would here refer to

anything other than the oral defence at the disputation, or even Rydelius's academic efforts in a wider perspective.

Theses:

84. **De Soni natura]** The first thesis of this second dissertation is in reality only a short recapitulation of the content of the previous dissertation on sound. The connection is made even stronger by the almost completely literal quotation (the reader can easily compare) of a large section from the last thesis of the former dissertation, a quotation indicated by the italics. A small, but noteworthy, difference between the quotation and the quoted text is, though, that the latter has *quomodo hi effectus*, while in this thesis we read *quomodo hi affectus*. Unfortunately it is impossible to decide whether the change was made by Vallerius himself, or is merely the mistake of a careless typesetter. However, the sense is virtually the same in both variants.

85. **summam esse efficaciam ... satis admirandam esse vim]** The idea of the wonderful and strange powers of music is Platonic, and the stories of what could be achieved through music are numerous in antiquity (see further West 1992, pp. 31 ff. and 246 ff.; as well as Mathiesen 1999, especially pp. 545 ff.). Some examples were given at the beginning of thesis 83 above. For an overview of the idea in the 17th century, when it was generally embraced (*Philosophi uno ore demonstrant vel concedunt omnes*) see Palisca 2006, pp. 179 ff. For a sketch of representative sayings on the subject in musical discourse of the time, see Sarjala 2001, pp. 11 ff.

per artem fortassis Oratoriam] Within rhetorics, moving the affects is also one of the purposes of the good speaker, according to Aristotle. We later see this clearly in Quintilian's famous *docere, movere, delectare* (*inst.* 12.2.11). The latter likewise considered the knowledge of music to be indispensable to both poets and orators, as well as grammarians (*inst.* 1.10.9–18). It was also with the revival of ancient rhetoric during the Renaissance that interest was once again aroused in the affect-moving potency of music. In comparison to rhetoric, however, Kircher states that music has a much greater power to stir the affects. Only a person who has not read the works of the ancient writers could claim differently (Kircher 1650, vol. 2, p. 141). For general treatments of the relation of music and rhetoric in the 17th century, see e.g. Palisca 2006, pp. 203 ff.; Braun 1994, pp. 328 ff.; McCreless 2002, pp. 851 ff.; and *MGG*, vol. 6, cols. 830 ff. In the dissertation *Rhetor musicus, seu specimen academicum de vi et usu musices in rhetorica* ('Orator musician, or academic specimen on the power and use of music in rhetoric'), defended in Turku (Åbo) 1703 under the presidency of Christiern Alander, which is in its entirety devoted to this subject matter, it is thus stated that the musician, just like the orator, should try to win the the listeners' benevolence and get to

know their affects and temperaments, if he wants to bring about a noble effect. Likewise the orator should adapt himself to the customs of the musician, who knows all of this well and can bring it into practice. The two disciplines are so interrelated that one of them cannot do, or cannot do well, without the other (p. 15):

Musicus igitur, auditorum benivolentiam [sic] instar Rhetoris et Oratoris sibi conciliare, se in eorum amicitiam insinuare, temperamentum et ingenium, atque affectus animi sibi nota facere debet, si nobilem effectum producere velit, vel saltem cavere debet, ne odio habeatur, quemadmodum Rhetor, vice versa se componere debet, ad morem Musici, qui ista omnia probe norit, et ad praxin producere potest. Adeo hae disciplinae se mutuo respiciunt, ut una sine altera vix esse, aut bene esse, possit ...

praejudicia] Both Noltinius (col. 675) and Krebs & Schmalz disapprove of the word in the sense that we meet it here, viz. the German *Vorurteil*, but in modern lexica it is accepted as Classical (*OLD*, s.v. *praeiudicium*, 3).

complexiones] The word appears in medical contexts about bodily constitution and temperament in late Latin (Forcellini, s.v. *complexio*, 5; Blaise [1], s.v. *complexio*, 5). It is rejected by both Krebs & Schmalz and Noltinius (col. 474). Micraelius (1661, col. 309) explains it as: *Physicis dicitur temperamentum. Unde alia complexio dicitur temperata, alia intemperata; item alia calida, alia humida*. Behind the concept lies an idea of a ‘combination of supposed qualities (*cold* or *hot*, and *moist* or *dry*) in a certain proportion’, and sometimes it thus even refers to the combination of the four bodily humours (*OED*, s.v. *complexion*, I, 1, a). See, however, also Kircher, who explains why different affects are roused in men of different complexion in the *Musurgia* (1650), especially in vol. 2, pp. 211 f.

86. **commotus vel praeoccupatus fuerit]** The shifted perfect passive again. See the notes on the phenomenon in the discussion on syntax in section 1.5.1 above.

unum ... alterum] As regards the construction, see the commentary on thesis 57 of *De sono* above.

87. **a posteriori]** The phrase, which we also commonly see in literature of our own time, appears in medieval logic for argumentation from effects to causes, thus almost in the sense of ‘inductively’ (Latham, Blaise [2], s.v. *posterior*). Micraelius (1661, col. 1076) accordingly explains it as a proof in which a cause is proved by its effect: *A posteriori dicitur demonstratio, quando per effectum demonstratur causa, et nihil aliud est, quam demonstratio ὅτι*.

88. **Philosophi ... tribuere solent]** Among the Greek philosophers the capacity of music to rouse affects in men depended not only on the modes, but also on the range of the voice, pitch-level, genus, rhythm and meter. Believing that the ancient modes were the same as the church modes, Gafori then in his *Practica musica* (1496) thought that the moods roused by music according to the ancients could also be connected to certain church modes. With the humanist movement, the modes were then considered to be ‘the key to music’s power’. In following ages, however, the musical authors display much divergence on which moods should be attributed to which modes (Palisca 2006, pp. 73 f. and 86. See also Palisca 1990). This last fact shall later be treated by Vallerius in greater detail.

Modis ... Musicis] As will be even more obvious below, and as one could expect from a music theorist of this time, Vallerius belongs to the tradition of Heinrich Glarean when considering the modes to be twelve. But in this thesis and the next, we could assume that Vallerius has probably followed Descartes’s *Musicae compendium*. Descartes starts his treatment of the modes, after having stated that they are so well-known that they do not require an explanation, by saying how they are created, viz. from the fact that the octave is not divided into equivalent steps, for there are both tones and semitones in it, as well as from the fifth, which is the sweetest sounding tone to the ear. For the octave can be divided in no more than seven different ways ... (1978, p. 66):

... hi [modi] autem oriuntur ex eo, quod octava in aequales gradus non sit divisa, modo enim in illa Tonus, modo semitonium reperitur. Praeterea ex quinta, quia illa omnium auribus acceptissima est, et omnis cantilena hujus tantum gratia facta esse videtur, 7 enim duntaxat diversis modis octava in gradus potest dividi ...

Some lines later, Descartes mentions that there are three primary terms in a mode, and likewise that they are called ‘modes’ since they confine the song, and since they are suitable for containing different songs:

Tres in quolibet modo sunt termini principales, a quibus incipiendum et maxime finiendum, ut omnes norunt. Vocantur autem Modi, tum ex eo quod cantilenam cohibent, ne ultra modum hujus partes divagentur, etiam praecipue, quia illi apti sunt ad continendum varias cantilenas ...

Worth noting here is that Mersenne considered the primary terms of a mode to be four, viz. note one, three, five and eight (Mersenne 1648, p. 110).

In Kircher, the modes are defined in two ways: as ‘a certain method of giving shape to the concentus, established in order to give a certain equality to the high and low pitches at the beginning, in the middle, and at the end’ (*certa quaedam musici concentus formandi ratio, in principio,*

medio et fine ad certam tum intensionis remissionisque aequalitatem ... formandam instituta), and as ‘kinds of harmony, which come about from the seven species of the diapason, depending on the varying division and connection of the fourth and the fifth’ (*harmoniae genera, quae ex 7 diapason speciebus pro varia quartae aut quintae divisione et connexione oriuntur*). In both definitions Kircher also stresses their aim of expressing certain affects (1650, vol. 1, p. 151, cf. p. 228).

The literature on the modes in music history is vast. For brief surveys, with many references to further reading, concerning the aspects of this and the following thesis, see e.g. Palisca 1985, pp. 280 ff., and 2006, pp. 71 ff.; Lester 1989, pp. xii ff.; Braun 1994, pp. 123 ff.; *HMT*, s.v. *modus*, III; *GMO*, s.v. *Mode*, §III: *Modal theories and polyphonic music*; and *MGG*, vol. 6, cols. 397 ff.

7 Octavae speciebus] In Kircher’s explanation, since the diapason is made up of the diapente and the diatessaron, the species of the octave can be obtained by uniting the species of the fourth and the fifth. The fourth has three species, and the fifth has four. The octave thus has seven species (1650, vol. 1, p. 149), i.e. seven different ways of arranging the tones and semitones within the octave.

termini] Within mathematics, *terminus* refers to each of the quantities that form a ratio, but also to each of the quantities that form a series, and the word was used in analogy with this in logic (see Micraelius 1661, cols. 1332 ff.). It was first attested in this sense in Boethius, as a Latin equivalent to the Greek ὄρος, which just like *terminus* originally meant ‘boundary mark’ (*OED*, s.v. *term*, IV [note], cf. Blaise [1], s.v. *terminus*, 4). We can easily conclude that it was used similarly within music theory at the time, e.g. in the quotation from Descartes’s *Musicae compendium* above, but also from many other passages from this work, e.g. (1978, p. 10): *ex duobus terminis, qui in consonantia requiruntur* (i.e. a proportion of 1:2).

clausulis Principalibus] The term *clausula* was initially rhetorical, but was also used in music from the early Middle Ages onwards. From the 12th century onwards it refers especially to formulaic endings in polyphonic music (*HMT*, s.v. *clausula*, III; cf. *DMLBS*, s.v. *clausula*, 2, a; *LML*, s.v. *clausula*, 2; *MGG*, vol. 5, cols. 256 ff.; and Walther; see also Palisca 2006, pp. 64 ff.; and Braun 1994, pp. 234 ff.). Calvisius, in his *Exercitationes musicae duae* (1600, p. 4), in his definition of mode states that ‘mode is in music a modulation confined by a certain range, by cadences, and by an ending’ (*Modus in musicis est modulatio certo ambitu, clausulis, et fine conclusa*). The cadence itself he somewhat later defines as a modulation, by which it either abates or passes over to rest, when some part of the text is finished. It occurs on the principal points of the interval of the diapente, viz. above all on its lowest tone, on its

highest, and on the middle tone, where the diapente is divided into ditone and semiditone (p. 10):

Clausula est modulatio, qua ad quietem aut inclinatur, aut transit, ubi pars aliqua textus finitur. Fitque in principalioribus locis intervalli διὰ πέντε, videlicet primum et principaliter in eius Clave infima, ubi et finis Cantilenae constituitur. Deinde in suprema, ex qua prior pars Cantilenae dependere solet, et in media, ubi διὰ πέντε in Ditonum et Semiditonum dividitur.

As can be seen, the definition of cadence in Bellman / Vallerius (1706, p. 37) is very similar: *clausulae seu cadentiae ... Definuntur clausulae per modulationis actum, in quo cantus ad quietem inclinatur, et aliqua Textus pars finitur.*

It should be stressed that the cadences at this time are still usually considered to be contrapuntal or melodic, while in the 18th century they would become more harmonically distinguished (*GMO*, s.v. *clausula*, cf. *GMO*, s.v. *cadence*, 2). The two kinds had, for instance, been acknowledged by Burmeister (1993[1606], p. 106): *Clausula est duplex: τοῦ μέλεος sive melodiae, et τῆς ἁρμονίας sive harmoniae.*

Modos dictos esse] This customary etymological explanation is certainly based on *modus* in the sense of ‘measure’, or even ‘limit’. Descartes also expressed this similarly in *Musicae compendium* (1978, pp. 66 ff.), as we saw above in the second quotation of the first comments (*Modis ... Musicis*) on this thesis.

Johannes Affligemensis, however, had in the 12th century contended that *modus* acquired its name from *moderando* or *modulando*, since singing is regulated or modulated by the modes (*HMT*, s.v. *modus*, III, 2).

89. ad numerum Modorum] As Vallerius says, there are several different opinions on the number of the modes. As Kircher states in a similar saying (1650, vol. 1, p. 565): ‘some say that there are only three, others eight, others 12, 13, 14, 15, 24, and finally there are some who establish 72’ (*Alij tonos tantummodo tres, octo alij, alij 12, 13, 14, 15, 24. Denique non desunt, qui 72 constituent*). See further Braun 1994, pp. 129 ff.

Quamvis autem juxta 7 Octavae gradus in Scala ...] Following directly upon the first quotation from Descartes’s *Musicae compendium* in the commentary on thesis 88 above is a section that likewise explains why the modes are twelve and not fourteen, viz. since a false fifth (*falsa quinta*) can be found instead of a fifth in two of them (1978 p. 66):

... quorum unusquisque duobus iterum modis a quinta dividi potest, praeter duo, quorum in uno quoque semel reperitur falsa quinta loco quintae, unde orti tantum duodecim modi ...

As we know, the authentic and plagal modes with finals on C and A had been added to the eight medieval ones in Glarean's system (cf. *GMO*, s.v. *Glarean, Heinrich*), and the modes with a final on B were thus avoided, because of the false fifth. Cf. Kircher's two different explanations of how the twelve modes arise: from the seven species of the diapason, and by a harmonic and arithmetic division and disposition (1650, vol. 1, pp. 155 ff., cf. pp. 228 ff.). See also thesis 95 below, on the seven octave species.

quia ... reperiatur, adeoque ... constituerit] According to Classical standards we would have expected an indicative form after *quia* here, but the subjunctive does occur rather often in such clauses somewhat later in antiquity (K.-St., II, pp. 384 f.).

minus naturalem] As before, *naturalis* is here meant in a technical sense. Walther (s.v. *Naturale*) explains the word as, among other things: *so viel als diatonisch*. In two places a false fifth would come about in the diatonic scale, but these false fifths could only be adjusted by making the scales chromatic.

parum vel nihil ad nostrum jam faciunt institutum] Vallerius will neither treat the order nor the names of the modes here, he declares. Descartes ends his short treatment of the subject quoted here in a very similar way, but he instead refrains from dealing with the power of music on human minds (1978, p. 67):

Et jam quidem sequerentur, ut de singulis animi motibus, qui a Musica possunt excitari, separatim agerem, ostenderemque per quos gradus, consonantias, tempora, et similia, debeant illi excitari, sed excederem compendii institutum.

90. **Sunt illi Modi]** As was already mentioned above, Vallerius basically follows Glarean in his treatment of the modes (cf. Moberg 1929, p. 69). In relation to Glarean, however, we notice that the names differ somewhat. Vallerius calls the 9th and 10th modes Ionian and Hypoionian, which in Glarean are labelled as Aeolian and Hypoaeolian, while Vallerius's 11th and 12th modes Iastian and Hypoastian are in Glarean called either Iastian and Hypoastian or Ionian and Hypoionian (Glarean 1965, vol. I, pp. 114 ff.). Vallerius also differs from Glarean and other readers of the ancient music theorists, who have usually given the hypoastian mode the species *d – G – d'* (hypomixolydian), not the species *g – C – g'* (hypoionian). Nonetheless, Vallerius's model was later also spread to a greater audience in Orostander's manual for schoolboys from the end of the 17th century (see Lundberg & Sjökvist 2010, pp. 82 ff. and 106 f.).

claves] As we have seen, *clavis* is first attested as a musical *terminus technicus*, in medieval Latin (cf. also *LLNMA*, s.v. *clavis*, 3, a; *DMLBS*, s.v. *clavis*, 4). In the present context, *claves* more precisely refers to the

tonal limits of the modes under discussion (cf. *LML*, s.v. *clavis*, 1; and *HMT*, s.v. *clavis*, II). For a sketch of the more exact sense of the term in music theory at the time of Vallerius, see Walther, s.v. *chiave*.

91. **Quod jam ad Harmonicam Chordae divisionem pertinet]** The division of the string has been used for describing consonances and dissonances by ratios ever since Pythagoras (whose ideas are summarized in Kircher 1650, vol. 1, pp. 533 f.), and its explanatory usefulness was still evident in the 17th century (see further Braun 1994, pp. 47 ff; and Cohen 1984, pp. 1 ff., and pp. 164 f., on Descartes's version of it). For, as Descartes states, a sound is related to a sound as a string is to a string, although in any string all shorter strings are contained in it, but not the longer ones. Thus also all sounds of higher pitch are contained in any sound, but not the lower ones. Therefore higher sounds are to be found by an arithmetic division of a lower sound (1978, p. 10):

Sonus se habet ad Sonum ut nervus ad nervum, atqui in quolibet nervo omnes illo minores continentur, non autem longiores, ergo etiam in quolibet sono omnes acutiores continentur, non autem contra graviore in acuto, unde patet acutiorem terminum esse inveniendum per divisionem gravioris, quam divisionem debere esse arithmeticam ...

Although it shall here be presumed that Vallerius has primarily followed Descartes's treatment of the division of the chord, he could of course have found similar ones in much of the other literature on the subject of the time. In Mersenne, for instance, we find this in his *Harmonicorum libri XII* (1648), on pp. 57 f. In Kircher, we find it in the *Musurgia* (1650), vol. 1, pp. 171 ff.

- vel in ordine ... ad se invicem relatas]** Even here, Vallerius has probably followed Descartes's *Musicae compendium*, where the division of a string serves to illustrate how all consonances are contained within the octave. The two possible ways of dividing the string (cf. Lester 1989, pp. xix ff.), of which Vallerius just as Descartes follows the latter in thesis 93 below, and the first in thesis 97, are mentioned in Descartes, but are not as expressly separated and emphasized as in Vallerius (1978, p. 16 ff.):

... considerandum est AB, qui gravior est terminus, dividi in D, non in ordine ad se ipsum, tunc enim divideretur in C, ut ante factum est. Neque enim jam dividitur unisonus, sed octava, quae duobus constat terminis, ideoque dum gravior terminus dividitur, id fit in ordine ad alium acutiorem, non ad se ipsum.

92. **comma]** As a musical term, the word, from the Greek κόμμα ('that which is cut off' [from κόπτω]), is late Latin (Blaise [1], s.v. *comma*, 3;

TLL, s.v. *comma*, 1817, 73 ff.). At the same time, Walther (s.v. *comma musico*) similar to Vallerius explains it as:

... ein gar kleines, und in der Scala Diatonico-Syntona in proportionē sesquioctogesima (81 gegen 80) bestehendes, an sich selbst aber nicht zu gebrauchendes intervallum, welches vernommen werden kan, wenn eine Saite in 81 gleiche Theile getheilet, und 80 Theile davon angeschlagen werden.

Kircher likewise says that the comma comes about from the difference between the major and minor semitones, and what arises is the *proportio sesquioctogesima* (1650, vol. 1, p. 102). For the different senses of *comma* in Antiquity, see the short article in *GMO*.

Semitonium minus ... Semitonium majus] Walther (s.v. *semitonium*) explains *semitonium majus* as *der grosse unvollkommene Ton*, z. E. *cis d [e f.] h c*, and *semitonium minus* as *der kleine unvollkommene Ton*. z E. *c cis [f fis] u. d. g*. Kircher similarly explains the major semitone as ‘the amount by which the fourth exceeds the ditone’, and the minor as ‘the amount by which the ditone exceeds the semiditone’ (1650, vol. 1, p. 101). While the major semitone has the proportion of 16 to 15, the minor has 25 to 24 (Lippius 1612, fol. B8v).

Tonus minor ... Tonus major] Walther explains *tonus* (2) as: *ein gewisses abgemessenes intervallum, so einen gantzen Ton ausmachet, welcher entweder major oder minor ist*. There are in just intonation two kinds of whole tones, the major and the minor. While the major has the ratio of 9:8 (the same as the Pythagorean whole tone), the minor has the ratio of 10:9 (*GMO*, s.v. *tone* (i)), as Vallerius also explains it later in this section. In Kircher the major tone is also called *secunda maxima* and *sesquioctava*, while the minor tones have the parallel designations *secunda* and *sesquinona* (1650, vol. 1, p. 101).

tritonus] The word τριτόνοϛ is first attested in the 2nd century AD in Greek music theory (*HMT*), while in Latin not until the Middle Ages (Blaise [2], Du Cange). Walther (s.v. *Tritono*) explains it as: *ein aus drey gantzen Tonnen bestehendes intervallum, oder die Quarta superflua*. In Kircher it is also labelled *quarta maior* (1650, vol. 1, p. 97).

semidiapente] The word probably first occurs in Latin in the Middle Ages. It can for example be attested in Ramus de Pareia’s *Musica practica* (ed. Wolf 1901, p. 50). Walther explains the word as: *eine unvollkomene Qvint, welcher ein Semitonium minus mangelt*. In Kircher it is also named *quinta imperfecta* (1650, vol. 1, p. 98).

Kircherum, Musurgia, lib. 3] The third book of Athanasius Kircher’s *Musurgia universalis* accordingly has the subtitle (1650, vol. I, p. 50): *De harmonicorum numerorum doctrina* (‘on the doctrine of harmonious

numbers'). A table with the most important proportions can be found on pp. 103 f.

Mersennum, *Harmonia*, lib. 4] The reference goes to book 4 of Mersenne's *Harmonicorum libri XII* (1648), which has the title *De sonis consonis, seu consonantiis* ('on consonant sounds, or consonances'). On p. 59 Mersenne has a *tabula consonantiarum* that includes the same proportions as in Vallerius's table, but also many more.

Riccioli, *Almagestum*, lib. 9, sect. 5] Section 5 in book 9 of Giovanni Battista Riccioli's *Almagestum novum* (1651) has the heading *De systemate mundi harmonico*. There we find tables of consonances and dissonances in pp. 509 f. Moreover, Vallerius's acquaintance with Riccioli's works is visible in the list of books borrowed from Uppsala University Library from the time. At four different times after 1694, when the list starts, Vallerius borrowed books written by Riccioli (Uppsala University Library, *Bibl. arkiv*, G:1).

93. **Sit jam Chorda AB ...]** The explanation of the division of the string is, as was said above, close to a corresponding passage on the matter in Descartes's *Musicae compendium* (1978, pp. 16 ff.), and a similar illustration is used. The section begins with a repetition of the statement that all consonances are contained within an octave, and then it continues by saying that A B is at the distance of an octave from A C, and that the part with the sound C B is thus the space of an octave. The latter should be divided into two equal parts, in order for the entire octave to be divided, and this happens at D (p. 16):

Quid autem sit quod dividi debeat, patet in nervo A B, quod distat ab A C, parte C B, sonus autem A B distat a sono A C una octava, ergo spatium octavae erit pars soni C B. Illa est igitur quae dividi debet in duo aequalia, ut tota octava dividatur, quod factum est in D ... [etc.]

GE divisa bifariam in F] The illustration does not help us at this point. The print does not show any F indicated on the imagined string, but as we can understand, F is meant to be situated exactly halfway between G and E.

ex sola hac chordae divisione ... intervalla habebimus] The reason why all primary intervals can be found in a string, besides the fact that all consonances are contained within an octave, is given more explicitly in Descartes's *Musicae compendium* (1978, p. 10), where we read that all smaller strings are contained in every longer string, and thus all higher sounds contained in every lower sound. A higher sound can thus be found through the division of lower one:

... in quolibet nervo omnes illo minores continentur, non autem longiores; ergo etiam in quolibet sono omnes acutiores continentur, non autem contra graviores in acuto. Unde patet acutiorem terminum esse inveniendum per

divisionem gravioris, quam divisionem debere esse arithmetica[m], hoc est in aequalia, sequitur ex praenotatis.

94. **gradus reliqui, per quos ... transitum facimus]** Descartes likewise writes at the beginning of the chapter *De gradibus sive tonis musicis* (on steps or musical tones) in his *Musicae compendium* that steps are required in music for two reasons, one of which is the need for one consonance to be able to pass on to another consonance (1978, p. 28):

Duabus maxime de causis requiruntur gradus in Musica, nempe ut illorum adjumento ab una consonantia ad aliam fiat transitus.

gradus in scala Diatonica ...] The following section mentions aspects that are treated in the chapters I, II and VIII of Orostander's *Compendium musicum*, where the staff, clefs and intervals are explained for beginners (Sjökvist & Lundberg 2010, pp. 68 ff. and 80 ff.). In Vallerius's text we see that solmisation is still mostly used in practice. Orostander prefers the use of letters designating the intervals, but thinks that everyone should choose the method they prefer (for a general treatment of *scala* in music theory of the time, see Braun 1994, pp. 68 ff.).

Constabit una ... semitoniis majoribus] Cf. again Descartes's *Musicae compendium* (1978 p. 32), where it is stated that an octave consists of three major tones, two minor tones, and two major semitones:

... ita integra octava constat tribus tonis majoribus, duobus minoribus et duobus semitoniis majoribus.

Eo autem ordine ... necessario semitonium] Descartes on this matter likewise writes that a major semitone must always have a major tone beside it on both sides, and the same is the case with the minor tone (1978 p. 34):

Iam vero de ordine, quo gradus illi in toto octavo [sic] spatio constituendi sint, est agendum, quem dico necessario esse debere talem, ut semper semitonium majus habeat utrimque juxta se tonum majorem, item et tonus minor, cum quo scilicet hic ditonium componat.

96. **Chordam ... in numeris th. XCII datis dividere]** Having illustrated in thesis 93 the primary intervals of the arithmetical method of Descartes (see quotation in the commentary on thesis 93 above), Vallerius in this thesis does the same with all intervals, both consonant and dissonant ones, accounted for in thesis 92. He does so by beginning from the same model as Descartes had employed, in an example where A B is divided into three equal parts, in which A C and A B are at the distance of a twelfth from

each other, the twelfth being made up by an octave and a fifth, and likewise, Descartes says, it is in other cases (1978, p. 14):

... exemplum sit A B divisus in tres aequales partes, ex quibus A C, A B distent una duodecima, dico illam duodecimam componi ex octava et ejus residuo, nempe quinta. Componitur enim ex A C, A D, quod est octava, et ex A D, A B, quod est quinta, et ita accidit in caeteris ...

97. **priori modo, in ordine ad seipsam**] The *priori* accordingly refers to the first of the two variants accounted for in thesis 91 above. We also find a division of this kind made in Kircher (1650, vol. 1, pp. 180 f.).

98. **nec etiam ... convenire inter sese Auctores Musices**] As regards these differing opinions of musical authors, which must have been widely known at the time, cf. e.g. Kircher 1650, book 8, p. 142: *Cum vero maxima sit Authorum de tonorum natura controversia.*

The confusion can perhaps partly be explained from a misconception in the 9th century, when ‘the names Hypodorian, Hypophrygian, and so on, were mistakenly applied to the set of octave species beginning on A’ (Palisca 2006, pp. 74 f.). Musicians nevertheless believed that the church modes and the Greek modes were the same. In addition, Greek music theory and the medieval tradition both spoke of seven diatonic octave species. In the latter, however, one of these species was rejected, and the ethnic names were attributed to different octave species. In general the musical authors display a considerable lack of consistency when attributing moods to modes, and ‘the ethical characteristics of the Greek modes were often unwittingly assigned to the similarly named medieval modes’. Later, Zarlino would claim that the great divergences as regards the modes had been caused by ‘changing customs and usages, a lack of understanding by writers, and errors of transmission’ (Palisca 2006, pp. 78 ff.).

Kircheri artem magnam Consoni et Dissoni, lib. 7, pag. 554] Vallerius’s reference to Kircher’s *Musurgia* (1650) is correct, but in some of the copies consulted during this work, there is an error in pagination at these very pages. The section referred to, where Kircher relates which affects the ancients attributed to the modes, can be found on page 620 (i.e. 554) of book seven. The quotation at the end of Vallerius’s thesis is taken exactly literally from pages 620–617 (i.e. 554–555). As we shall see, Vallerius obviously takes Kircher’s statement here on the confusion among the ancients as a point of departure for an investigation of the modes in contemporary authors, with the aim of demonstrating that the case is the same with them. Kircher also states the same confusion of the ancients at the beginning of the short treatment in book 3, p. 151, and in book 5, p. 228 (for a comparison of other opinions on the ethos of the modes, including those

from the Classical, medieval and Renaissance eras, see Palisca 1990, pp. 129 ff.).

Tonis] As we can see from the context, the word is here used in the sense of *modus* (cf. Walther, s.v. *tonus*, 3; *GMO*, s.v. *tonus* (iv); *MGG*, vol. 6, cols. 397 f.; Barnett 2002, pp. 419 f.; and Bartal). The word, which is the Greek *τόνος*, was used thus in ancient Greek music theory, and the sense was later introduced into Latin in Boeth. *mus.* 4.15 *ex diapason igitur speciebus consonantiae existunt, qui appellantur modi, quos eosdem tropos uel tonos nominant.*

99. **In pag. vero 573 et sequentes ... exponit Kircherus]** Under the heading *Paradigmata musicae patheticae in 12 Tonis exhibita*, Kircher in book seven of the *Musurgia universalis* (1650) connects each mode with certain affects in vol. 1, on pp. 573–577. Similar accounts also appear, however, in other places, e.g. also in vol. 1, pp. 554 f., and vol. 2, pp. 142 f.

Milliet] The author referred to is Claude François Milliet Dechales (1621–1678), the French Jesuit and mathematician. We find the section referred to here under the heading *Musica* in the third volume of his *Cursus seu mundus mathematicus* (1674, vol. III, pp. 32 f.), where there is an account of the twelve modes in contemporary authors. The word *Domini*, which is probably due only to the circumstance that Milliet was a Catholic priest, has here been left without translation.

Vallerius's close acquaintance with the book of Milliet Dechales, which was very widely disseminated in Europe at the time, has been stressed by Staffan Rodhe. For instance, Vallerius borrowed the *Cursus seu mundus mathematicus* from the university library of Uppsala no fewer than 15 times between 1697 and 1705. Supposedly, Vallerius had founded his teaching in mathematics on the book of Milliet Dechales (Rodhe 2002, vol. I, pp. 17 and 20; cf. Uppsala University Library, *Bibl. arkiv*, G:1).

ex Petri Gassendi manu ductione ad Theoriam Musicam] In the *Opera omnia* (1658) of Pierre Gassendi (1592–1655), the French philosopher, scientist and mathematician, we find his *Manu ductio ad Theoriam Musices* as the fifth section of the fifth volume. Chapter four of this section deals with *De tonis, sive Modis Cantus*. A comparison of Gassendi's list of affects attributed to each mode (p. 657) with that of Milliet Dechales shows that Vallerius's suspicion is probably correct. The version of Milliet Dechales is very close that of Gassendi, in fact they correspond almost completely, even literally.

Primus Modus ...] The numbering of the modes in Vallerius's account follows Kircher's. The first mode in Vallerius (and Kircher), i.e. D–d, is that which Milliet Dechales labelled as no. 3, while nos. 1 and 2 in Milliet Dechales are nos. 11 and 12 in Vallerius (and Kircher).

Vallerius's quotations follow the texts of Kircher and Milliet Dechales very closely, for the most part only with some orthographical

and syntactical changes. More substantial differences and omissions are accounted for below.

Habet enim nescio quid energiae mirabilis] Kircher's formulation echoes Jerome's (*epist.* 53.2.2) *habet nescio quid latentis energieas viva vox*.

tripudio] While *tripudium* originally referred to 'a ritual dance in triple time' (*OLD*, s.v. *tripudium*, 1, cf. Noltenius, col. 1157), it rather signifies 'dance' in general at the time of Vallerius (JPG; *GMO*, s.v. *dance*, 3, i). Cf. e.g. Descartes 1978, p. 8: *in cantilenis, ad quarum numeros solemus saltare et tripudiare*.

moestitiae, miseriae et sollicitudinum] At this point we meet a small divergence between Milliet Dechaies and Vallerius. As was mentioned above, the *modestiae* of the original print has here been altered to *moestitiae*, which is the reading found in Milliet Dechaies: *moestitiae, miseriae et sollicitudini*. We are probably dealing with nothing more than a typographical error, largely due to the similarity between the words, and the fact that *modestam* occurs in the same paragraph. But as can be seen, Milliet Dechaies also had *sollicitudini*, while Vallerius has *sollicitudinum*. There is no real difference in sense, despite the different number, but the dative form also agrees better with the directives given in hand-books of the time (e.g. JPG and BFS, s.v. *idoneus*).

amat, et si cum] In the quotation from Kircher, Vallerius has omitted the subordinate clause between the comma and *et*, viz. *unde threnis aptissimus est* ('whereby it is most suitable to lamentations').

ad animam ... concitandum] Notably, in Kircher we here find *ad animum ... concitandam*.

similis est tertio, amat enim] Vallerius has between *tertio* and *amat* omitted a rather long section from Kircher, which states that even skilled musicians often confuse the third and the fourth modes, because of their similar cadences.

repercussionibus] The word is a hapax in Classical Latin in Sen. *nat.* 7.19.1, where it is used about the reflection of light. In Vallerius's time, however, it is a technical music term. It is found, for instance, in Dowland: 'the Repercussion [L. *repercussio*], which by Guido is called a Trope, and the proper and fit melodie of each Tone. Or it is the proper interuall of each Tone' (quoted from *OED*, s.v. *repercussion*, 3, b; cf. *HMT*, s.v. *repercussio*, III; and Lester 1989, p. xiv). Walther also defines it, in another context, as: *dasjenige intervallum, welches in einer Fuge der Dux und Comes, dem Modo gemäss, gegen einander formiren*. Kircher, however, explains the word as 'nothing other than a certain and proper interval. For every mode has its own clausulas or *cursus*, from which it can be decided by hearing alone, which mode they belong to' (1650, vol. 1, p. 235):

Repercussio nihil aliud est, quam certum et proprium intervallum. Habent enim singuli Toni suas clausulas seu cursus, ex quibus solo auditu, cuius toni sint, dignoscitur.

politus et lyricis versibus] In Milliet Dechales, the text is more precisely *politus seu comptus, et lyricis versibus accomodatus*.

harmoniosus] The Latin form that we usually meet is *harmonicus* (cf. e.g. Walther, s.v. *harmonieux*), and I have not been able to find *harmoniosus* in any other text than by Kircher himself. Possibly, its creation has been influenced by the French *harmonieux*.

Kircherus, lib. 8, pag. 51 et pag. 142] On page 51 of book 8 in vol. 2 of the *Musurgia* (1650), Kircher displays his *mensa tonographica*, in which the endless musical combinations are comprised in twelve columns. This table, in which the quality of each mode is also rendered in a few words, could be called ‘the basis and foundation of our entire *musurgia*’, Kircher contends.

On page 142 f. of book 8, after Kircher has stated that music stirs the affects of man just as rhetoric does, dividing these into the three main groups of happiness (*laetitia*), remission (*remissio*) and mercy (*miserericordia*), he continues by accounting for all twelve modes, and by summarizing their nature and properties in a few words.

100. **Mersennus, tractatus Gallicus harmoniae universalis]** The reference goes to theorem 29 in the first book of Marin Mersenne’s *Traité de l’harmonie universelle* (1627, pp. 244 ff.), where the French philosopher explains the eight church modes, compares these with twelve musical modes, and relates the properties of the latter.

Commentarius in Genesin et quid in Cap. 4, versic. 21] The reference is to section 21 of chapter 4 of Mersenne’s *Quaestiones celeberrimae in Genesin* (1623). There he treats the music of the ancients, and from whence the power of music comes, among other things. Included under article no. XIII, which has the heading *De modis harmonicis tam recentiorum, quam antiquorum*, Mersenne has an illustrated table where the twelve modes are displayed and connected to certain affects in particular (cols. 1675–1678).

Kircherus Musurgia, lib. 7, pag. 555] We met a literal quotation from Kircher’s *Musurgia* (1650) at the end of thesis 98 above, and here we find another from the same passage. After the *appellant*, with which the former quotation ends in vol. 1 on p. 617 (= 555), the new clause begins: *Quae diversitas et apud Neotericos mirum in modum discrepat, cuius quidem rei ratio alia non est, nisi complexionum diversitas ...* Vallerius then renders Kircher’s words exactly, only with an adaption to the *accusativus cum infinitivus*-construction of his own text. The expressed idea also recurs at several other instances in the *Musurgia*, e.g. vol. 1, p. 571.

101. **omne quod recipitur ad modum recipientis recipi]** The idea is a commonplace in philosophical literature. However, as the formulation is rendered here, we can notice the close similarities with several instances in Thomas Aquinas, e.g. the *Summa theologiae* (1a, q. 75, a. 5): *Manifestum est enim quod omne quod recipitur in aliquo, recipitur in eo per modum recipientis*. In one place, Thomas himself refers to the pseudo-Aristotelian *Liber de causis* as his source of his saying (*Quaest. disp. de potentia*, 3.3.1): *Ut enim dicitur in libro de causis, omne quod recipitur in aliquo, est in eo per modum recipientis*.

nihil debet esse in iudicio quod prius non fuit in perceptione] Unfortunately, it has not been possible to locate the exact source of this quotation. But the saying agrees with an idea traditionally attributed to Aristotle, which recurs in several medieval philosophers. Thomas Aquinas, for instance, wrote in *Quaest. disp. de veritate* (2.3.19): *nihil est in intellectu quod non sit prius in sensu*, and that sentence later returns in philosophers such as Locke and Leibniz. Even Descartes refers to it in the *Meditationes de prima philosophia* (1904, p. 75): *facile mihi persuadebam nullam plane me habere in intellectu, quam non prius habuissem in sensu*.

In the *Disputatio physica de qualitatibus corporum naturalium* (1700, p. 2) and the *Dissertatio philosophica de imaginatione* (1700, p. 27), both defended under Vallerius's presidency, we later meet the variant *Nihil est in imaginatione quod prius non fuit in sensibus* labelled as an *axioma vulgare*.

cum tali motu in organo ... conjuncta sit perceptio in anima] As regards the difficulties in explaining human perception at the time, see the commentary on thesis 2 of *De sono* above.

in respectu ad] The construction is first attested in medieval Latin (Avicenna Latinus, 12th century). It is equivalent to the typically Livian *respectu* with a word in the genitive case, and can certainly be explained by the extended usage of prepositions in post-ancient Latin for expressing functions previously only expressed with the case itself (on which see quite generally e.g. Stotz 1998, pp. 272 ff.).

Astrologi in arte sua judiciaria] As regards astrology in our modern sense of the word, i.e. star divination, see *OED*, s.v. *astrology*, 1, where we find a quotation from Chambers *Cycl.* (1727): '*Judiciary or Judicial Astrology, which we commonly call simply Astrology, is that which pretends to foretell moral events, i.e. such as have a dependence on the free will and agency of man; as if that were directed by the stars*'. In the 17th century the calculation and foretelling of natural phenomena (natural astrology) started to be counted under the discipline of astronomy.

Praedicamento] The word is late Latin (Blaise [1], *TLL*). Noltinius (col. 673) states that it is a *vocabulum logicum*. *Aristoteles vocat κατηγορίας, Cicero attributa rerum, item, summa rerum genera, Quintilianus elementa*. Krebs & Schmalz (s.v. *praedicare*) disapprove of it as well.

Micraelius (1661, col. 1084) likewise begins by saying about it that: *Praedicamenta sunt Graecis κατηγορίαι*.

102. Cadentiarum] The word appears in the sense of ‘cadence’ in the Middle Ages (*LML*, s.v. *cadentia*, 3; *MGG*, vol. 5, cols. 256 ff.; and Barta). Walther (s.v. *Cadence*) accordingly explains it as *ein Stimm-Fall, Gesang- oder Harmonie-Schluss, dienend, ein Musicalisches Stück entweder gänzlich, oder nur zum Theil zu endigen ...* Descartes, likewise, describes it as specific groups of tones that always end in a most perfect consonance, occurring at the end of the song so that the ears do not expect anything further (1978, pp. 58 ff.):

Ut in fine cantilenae ita auribus satisfiat, ut nihil amplius expectent ... quod fiet per quosdam tonorum ordines semper in perfectissimam consonantiam desinentes.

Later, Descartes certainly also mentions that cadences can occur with much delight in the middle of the song. As figures in music, they are just as figures in rhetoric (1978, p. 66):

... etiam in medio cantilenae hujus cadentiae fuga non parvam affert delectationem ... hoc est genus figurae in Musica, quales sunt figurae Rhetoricae oratione.

Kircherus, lib. 8 Musurgia] The first quotation from Kircher in this section is taken almost completely literally from book 8 of his *Musurgia* (1650, vol. 2, p. 14), from a chapter that deals with the combination of notes. Vallerius has omitted one sentence about how incredible the facts mentioned are for those who are not familiar with the nature of the numbers and combinations. Between the *annis* and *Unde etiam patet*, Kircher thus also has: *Res omnino ijs qui vim numerorum et combinationis naturam nesciunt incredibilis, quae facile tamen ex praecedentibus demonstrantur*. The other difference between the texts here is that Kircher has *Motecta*, while Vallerius has *Motetta* (on which see below).

The second part of the quotation, after the *Imo*, is taken from p. 16 of book 8 of Kircher’s work, the only difference being that Kircher has an *autem* between *Combinatio* and *haec*.

However, for the third part, Vallerius has given the correct page reference himself, and the quotation corresponds exactly to the text in Kircher’s work.

voce] The word *vox* is at this time often used as a musical *terminus technicus* for ‘part’ in a choir. Besides in the general sense of ‘sound’ (cf. Tinctoris, s.v. *vox*), *vox* was at an earlier stage commonly used for the ‘singing syllables’ (cf. e.g. Tinctoris, s.v. *ut*: *Ut est prima vox tono distans a*

secunda). The sense of ‘part’, with its registral implications, had developed in the late Middle Ages (*GMO*, s.v. *part* (ii)). We find it expressed e.g. in the *Erotematum musicae* by Friedrich Beurhaus (1580, pp. 110 f.):

Partes vel ratione gravis et acuti soni due sunt, una Vox gravis, altera acuta: vel ex utriusque distinctione plures, sed praecipue quatuor principes, Basis, Tenor, Altus et Discantus: quae proprias sedes in sonorum ordinibus habent.

mutationum] *Mutatio* is also a technical term used in different ways in music history (see Walther, s.v. *mutatione*, where some of them are listed). But in this context we must understand the word in a general sense, as referring to the number of possible combinations arising from alterations of the tones, times, cadences, etc., which were mentioned above.

Motetta] The word, just as the motet itself, appears in the Middle Ages (Blaise [2], s.v. *motetum* (*motetus*); *DMLBS*, s.v. *motetus*; and *MGG*, vol. 6, cols. 499). As can be seen, Kircher treats the word as a feminine. Walther (s.v. *Motetto*) accounts for several different spellings and forms of the Latin word: *Motettus* oder *Mottetus*, *Motetus*, *Motectum*, *Moteta*, etc. Kircher describes the style as (1650, vol. 1, p. 585): ‘a harmonius procession, grave, full of majesty, florid with very great variety, not restricted to any subject’ (*processus harmonicus, gravis, maiestate plenus, summa varietate floridus, nullo subiecto adstrictus*).

mundana machina] The expression echoes Lucr. 5.95 f.: *multosque per annos / sustentata ruet moles et machina mundi*.

ab orbe condito] The phrase, modelled as it obviously is from the Livian *ab urbe condita*, referring to the founding of Rome, occurs as early as Orosius’s *Historiae adversum paganos* 1.1.14: *Dicturus igitur ab orbe condito usque ad Urbem conditam*.

Mersenne, lib. 7 Harmoniae, prop. 15] In proposition 15 of book 7 of the *Harmonicorum libri XII*, in which Mersenne wants to investigate how many different songs can come about from a given number of notes, he writes (1648, p. 141): *illa siquidem 22 temporum, et notarum varietas maior est quam ut totus mundus in papyrus conversus illam capere possit, ut facili calculo comprobatur*.

papyrus] While *charta*, mentioned some lines above in this thesis, in Krebs & Schmalz is called the correct Classical word for ‘paper’, *papyrus* is there labelled as late Latin (but cf. *OLD*, s.v. *papyrus*, 2). Both Krebs & Schmalz and Noltenius also stress that *papyrus* is the word generally used in Latin from the Middle Ages and onwards: *Hodie tamen chartam vulgo vocamus papyrus* (Noltenius col. 852).

103. **Tactum seu temporis mensuram]** Cf. here Vallerius's treatment of *tactus* in the earlier dissertation *De sono*, thesis 68–70, where it is explained as the 'length' of sound, and according to which we measure its time according to a certain measure: *In longitudine soni venit tempus considerandum, quo eum juxta certam mensuram metimur. Illa mensura vocari solet tactus*, but the matter is of course dealt with much more extensively in the dissertation *De tactu* below. There we find it stated that musical *tactus* is (thesis 7): *nihil aliud quam certa temporis mensura circa sonum observata et manus depressione et elevatione plerumque notata* ('nothing other than a certain measure of time that is taken heed of as regards sound, and that is for the most part marked out by the lowering and the raising of the hand').

quantum illa vel sola ... constare poterit] In the compendium of Descartes we read, in a passage that is very close to Vallerius's at the beginning of this thesis, although he uses some different words (1978, p. 8):

Non omittam tamen tantam esse vim temporis in Musica, ut hoc solum quandam delectationem per se possit afferre, ut patet in tympano instrumento bellico, in quo nihil aliud spectatur quam mensura.

As regards the Swedish words in the parenthesis, which simply mean 'kettledrums' and 'drums', cf. Walther, s.v. *tympanum*, who explains the word as *eine Paucke, Trummel*.

(vulgo pukor / trummor)] As regards *trummor*, see commentary on thesis 58 of *De sono* above. In Swedberg, both *puka* and *trumma* are translated as *tympanum* in Latin (cf. Hülphers 1969[1773], p. 88). But while *trummor* is 'drums' in English, we would more precisely render *pukor* as 'kettledrums'.

adeo naturalis ... ad Tactus mensuram saltare possint] The rest of the thesis, dealing with how natural *tactus* is for living beings, rather closely follows an only somewhat earlier section in Descartes (1978, p. 7 f.), where the French philosopher discusses this *tactus*, and more precisely the stronger and more distinct sound emitted at the beginning of every *battuta*:

Quod naturaliter observant cantores et qui ludunt instrumentis, praecipue in cantilenis, ad quarum numeros solemus saltare et tripudiare. Haec enim regula ibi servatur, ut singulis corporis motibus singulas Musicae battutas distinguamus, ad quod agendum etiam naturaliter impellimur a Musica. Certum enim est sonum omnia corpora circumquaque concutere, ut advertitur in campanis et tonitru, cujus rationem Physicis relinquo. Sed cum hoc in confesso sit, et ut diximus, initio cujusque mensurae fortius et distinctius sonus emittatur, dicendum est etiam illum fortius spiritus nostros concutere, a quibus ad motum excitamur, unde sequitur etiam feras posse saltare ad numerum, si doceantur et assuescant, quia ad id naturali tantum impetu opus est.

praxi] The word is the Greek $\pi\rho\tilde{\alpha}\xi\iota\varsigma$, and is only used with Greek letters in the sense of *actio* or *negotium* in Classical literature, with a possible exception in Petronius (cf. *TLL*). Vallerius's usage here is thus rejected in both Krebs & Schmalz and in Noltenius (col. 1117), who prefer the classical *usus*, among other words, for this sense.

battutam] The Italian word *battuta*, which has here received a Latin accusative form, is literally 'beat'. In Descartes it is used in that sense, but also as a virtual synonym to *tactus* as 'measure', see e.g. (1978, p. 6): *divisio notatur percussione vel battuta*, and on the same page: *haec mensura sive battuta*, and *initio cujusque battutae distinctius sonus emittatur*, but also the quotation under the previous lemma. In Walther's explanation the same can be noticed. *Battuta* is there: *der Tact; ist diejenige Bewegung der Hand, so durch Niederschlagen und Aufheben geschieht, die Halt- oder Währung der Klänge anzuzeigen*. Cf. also Praetorius (1619, III, p. 48): *De tactu, seu Notarum mensura; (Italis Battuta) et Signis*; and Kircher (1650, vol. 2, p. 52): *Itali vocant la battuta, Boetius plausum, alij tactum et mensuram*.

Chelyn vulgarem (vulgo Nyckelgijga)] As we have seen earlier, Walther (s.v. *chelys*) explained *chelys* as *allerhand Gattungen grosser und kleiner Geigen*. The *chelys vulgaris* thus in this case refers, as the Swedish word *Nyckelgijga* (i.e. *nyckelharpa*) in the parenthesis indicates, to the keyed fiddle, a folk instrument attested in church art in Sweden as early as the late Middle Ages (on which see Ling 1979; cf. Vallerius / Bergrot 1717, p. 31). Vallerius's claim here, about the players of these keyed fiddles, is indicative of the expressive vividness associated with playing the instrument at the time.

homines surdi, imo bruta ipsa] Cf. thesis 69 of *De sono* above, and the commentary on that thesis.

104. **Quomodo ... Physice comparatum sit ...]** In the long quotation from Descartes in thesis 103 above, we likewise met an explicit omission of a treatment of the power of *tactus* from a physical perspective (1978, p. 8): *Certum enim est sonum omnia corpora circumquaque concutere, ut advertitur in campanis et tonitru, cujus rationem Physicis relinquo*. But in Vallerius, the *praeteritio* leads to a statement that *tactus* will be treated at another occasion. As was mentioned in the chapter on the question on authorship above, we could thereby safely assume that Vallerius had from early on planned to investigate *tactus* as well. And this plan was realized with the dissertation *De tactu* in 1698.

105. **tertia ac sexta]** The third and sixth tones are of course differently located in different modes. Some are located on a minor, some on a major tone, and this, Vallerius contends, introduces yet another dimension in modal thinking (*in duplici sunt differentia*). The importance of the major

and minor sixth in this respect is due to the fact that the major sixth emanates from the major third, just as the minor sixth originates in the minor third (cf. Descartes 1978, p. 28). See also the commentary on thesis 75 of *De sono* above.

B durum ... B molle] As we know, the names *dur* and *moll*, which have survived as the designation for major and minor keys in many languages, and which Vallerius himself also uses throughout later in the Latin text, as if it was natural to do so even in Latin, have their origins in the two variants of ‘b’ in medieval musical notation, where *B durum* signified the pitch B[♮] and *B molle* meant B[♭]. After transposition, the symbols could there refer to third degrees also of other hexachords than merely the one on G (*LLNMA*, s.v. *durus*, 3, and *DMLBS*, s.v. *B*, 2, a+b, and *mollis*, 5; cf. *GMO*, s.v. *dur*; and *MGG*, vol. 2, cols. 1591 ff.).

in duplici sunt differentia] Vallerius does not call them keys, but as we can see he divides the modes into two different categories, depending on whether the third is major or minor. Just as Lippius, who stressed the importance of this difference between the modes, Vallerius treats the matter in the discussion of music’s influence on the affects (cf. Lester 1989, pp. 37 ff.).

106. **Ex hac Modorum diversitate ...]** The thesis is close to a section in Descartes, where the French philosopher has refrained from treating the power of the different consonances for raising the affects in men, since it would exceed the scope of his compendium, but yet he differentiates between two main groups, and mentions that the ditone and the major sixth are more pleasant and merrier than the minor third and sixth (1978, p. 28):

Id igitur tantum dicam hac de re, praecipuam varietatem ab his quatuor ultimis oriri, quarum ditonus et sexta major gratiores laetioresque sunt quam tertia et sexta minores, ut etiam a practicis fuit observatum, et facile deduci potest ex dictis, ubi tertiam minorem per accidens a ditono generari probavimus, sextam autem majorem per se, quia nihil aliud est quam ditonus compositus.

As we can see, Vallerius basically writes the same thing, but in different words, extended and elaborated. Just like Descartes he states the different moods connected to the *durum* and *molle*, he claims that practicing musicians have observed this, and he mentions the importance of the ditone and the minor third in this respect.

107. **Psalmis illis ex nostris Ecclesiasticis]** The word *psalmus*, from the Greek ψαλμός, enters into Latin in late antiquity (Blaise [1], *TLL*). Noltenius (col. 846) asserts that it should more precisely be used for mel-

odies played on musical instruments, while a song that is sung should be called *hymnus*. Krebs & Schmalz likewise recommend *carmen* or *hymnus* rather than *psalmus*, which they contend even in late Latin was only used on the Psalms of David. Similarly, the word *ecclesiasticus*, from the Greek ἐκκλησιαστικός, is late Latin (Blaise [1], *TLL*). According to Noltenius (col. 517), theological and ecclesiastical words of this kind should generally be accepted and rejected only with much consideration, especially when the subject is sacred.

As we saw in the chapter on Vallerius's biography above, he and Olaus Rudbeck would later edit the music for the first printed Swedish hymnal (1697). All of Vallerius's examples of melodies in this thesis can be found in the hymnal, so his statements can easily be compared to the printed settings there. Notably, Vallerius was also responsible for the setting of the additional figured-bass part included in this work (Hansson 1967, pp. 159 ff., and Göransson 1992, pp. 127 ff., with further references). The hymnal of 1697 is also available in a facsimile edition from 1985 (*Den svenska psalmboken 1695. 1697 års koralbok*). There is further information on all of the hymns mentioned in this thesis and in thesis 109 to be found in Göransson 1992, which has a useful index on pp. 240 ff.

På tigh hoppas iag o Herre kiär] No. 46 in the hymnal of 1697. The range of the hymn melody is b–d², it begins and ends on d¹, and it is notated without fixed accidentals.

Beklaga aff alt mitt sinne] No. 248 in the hymnal of 1697. The range is d¹–c², it begins and ends on g¹, and it is notated with one fixed flat.

O Menniskia will tu betenkia] No. 210 in the hymnal of 1697. The range is g¹–d², it begins and ends on g¹, and it is notated with one fixed flat. According to Göransson (1992, p. 120), this hymn is usually set with a melody in the major in older sources from the continent.

Medhan man lefwer i werlden säll] No. 380 in the hymnal of 1697. The range is c¹–d², it begins on c² and ends on e¹, and it is notated without fixed accidentals.

Gudh står i Gudz församlingh] No. 75 in the hymnal of 1697. The range is e¹–e², it begins b¹ and ends on e¹, and it is notated without fixed accidentals.

Aff diupsens nödh ropar iagh till tigh] No. 99 in the hymnal of 1697. The range is e¹–d², it begins b¹ and ends on e¹, and it is notated without fixed accidentals.

Fis] This designation for the semitone between F and G is attested in medieval Latin (*LML*). As the translation shows, Göransson's remark (1992, p. 73) that Vallerius here 'warns against substituting the F with and F sharp' misses the point completely.

Min Siähl skall lofwa Herren] No. 86 in the hymnal of 1697. The range is d¹–d², it begins and ends on g¹, and it is notated with one fixed sharp.

Hwar man må nu wähl glädia sigh] No. 219 in the hymnal of 1697. The range is c^1-c^2 , it begins and ends on f^1 , and it is notated with one fixed flat.

Sig fröjde nu Himmel och Jordh] No. 199 in the hymnal of 1697. The range is c^1-d^2 , it begins and ends on g^1 , and it is notated without fixed accidentals (cf. Göransson 1992, p. 118).

108. **secundarios ... Primariorum]** The ‘secondary’ mode is thus the plagal, the range of which is the octave between the 5th above and the 4th below the final, while the ‘primary’ refers to the authentic mode. In Johannes Lippius’s *Synopsis musicae novae* (1612), for instance, we also read that the designations are considered to be equivalent (fol. H8v): [*Modus Musicus*] *Estque aut Primarius seu Authenticus: aut Secundarius, qui ab illo non nisi subiectione differt, unde ... Plagius, Remissus seu Submissus vocatur.* (Cf. Walther, s.v. *Modus plagalis* and *Modus primarius*). In Mersenne, these and some other labels are used on them as well (1648, p. 107):

Sunt autem numero duodecim, sex nempe primarij, atque praecipui, quos Authenticos et dominos, atque Reges; et sex secundarij, quos Plagales, ministros, subiugalesque vocant.

In Kircher, the plagal is given the Latin designation *plagius*, and the authentic *authentus* (1650, vol. 1, p. 229).

109. **O Gudh hwem skall iag klaga, then sorgh]** No. 249 in the hymnal of 1697. The range of the hymn melody is e^1-c^2 , it begins and ends on f^1 , and it is notated with one fixed flat.

O Jesu Christ san Gudh och Man (ut hic Upsaliae canitur)] No. 383 in the hymnal of 1697. The range is f^1-d^2 , it begins and ends on f^1 , and it is notated with one fixed flat. In other places the hymn was sung with the melody of *Fader vår* (no. 9 in the Hymnal of 1697), for example in the hymnal of 1586 (Göransson 1992, pp. 57 and 73).

Wijdh the Elffwer i Babylon] No. 102 in the hymnal of 1697. The range is c^1-d^2 , it begins on c^2 and ends on f^1 , and it is notated with one fixed flat.

Till tigh aff hiertans grunde] No. 100 in the hymnal of 1697. The range is c^1-c^2 , it begins on a^1 and ends on d^1 , and it is notated without fixed accidentals.

Från Gudh will iag ey skillias] No. 283 in the hymnal of 1697. The range is d^1-d^2 , it begins on d^1 and ends on g^1 , and it is notated with one fixed flat.

Jesus är mitt lifff och hälsa] No. 141 in the hymnal of 1697. The range is c^1-d^2 , it begins on a^1 and ends on a^1 , and it is notated without fixed accidentals.

Alt hwadh wij å Jorden äga] No. 270 in the hymnal of 1697 (the melody is the same as in no. 245, composed by Gustav Düben). The range is f^1 – f^2 , it begins on f^1 and ends on B^{b1} . It is notated with two fixed flats, and with an *alla breve* signature.

Waka up aff synden tu Christendomb] No. 403 in the hymnal of 1697. The range is d^1 – d^2 , it begins on d^1 and ends on g^1 . It is notated with one fixed sharp, and with an *alla breve* signature.

Mig gör stoor lust och glädie] No. 412 in the hymnal of 1697. The range is e^1 – e^2 , it begins on h^1 and ends on g^1 . It is notated with one fixed sharp, and with an *alla breve* signature.

110. **Cantilena sit in C dur**] Seemingly, Vallerius is here close to the modern way of understanding *dur* ('major'). In this sense the concept was in fact used rather commonly at the time, as attested by Andreas Werckmeister (Lester 1989, pp. 88 f.). We notice in several ways in Vallerius's text that this is a transitional period between modal and tonal thinking (cf. e.g. Lester 1989, *passim*; Braun 1994, pp. 149 ff.; and Barnett 2002). Besides using the concept of *dur* in different ways, he also alternates between the Latin form *durum* and the German *dur*, but also between using the prepositions *per* and *in*.

quorum differentia est Comma, aliis schisma] In Lippius's *Synopsis musicae novae* (1612), for instance, we read (fol. C6v): *Tonus minor superatur a maiori per Comma* ('the minor tone is exceeded by the major with a comma'). The term *schisma*, however, can refer to different intervals in music history (cf. *GMO*), but Vallerius mentions it as a synonym of *comma*. In Boethius's (*mus.* 3.8) traditional, and most common (cf. Walther), definition *schisma* is actually 'the half of a comma' (*dimidium commatis*). But Vallerius's definition is in accordance with Descartes's terminology in the *Musicae compendium*, where it is explained as the difference between the major and the minor tone (1978, p. 36): *quae differentia sit inter tonum majorem et minorem, quam schisma nominamus* (also on p. 52). Probably Descartes was also Vallerius's immediate source when using the term, which he continues to employ in the next thesis. Worth noticing, however, is that in Bellman / Vallerius (1706, p. 23) *schisma* is later explained as the half of a *comma* (*schisma, quorum duo faciunt unum comma*).

111. **Violinum, seu Chelys minor**] Just as above, in thesis 26 of *De sono*, we here meet equivalent terms. Walther (s.v. *violino*) naturally explains *violinum* as *eine Discant-Geige* (cf. *GMO*, s.v. *violin*; and *MGG*, vol. 9, cols. 1597 ff.). Kircher in the *Musurgia* describes the *chelys minor* (with a picture of a violin) as a noble instrument, which is very suitable for expressing harmonious diminutions. It usually has four strings, and it compasses four octaves (1650, vol. 1, p. 486):

... nobile instrumentum, et ad harmonicarum diminutionum varietatem aptissimum. 4 ut plurimum chordis constat, quibus tamen ad 4 octavas usque ascendunt).

In Vallerius / Bergrot (1717, p. 32), however, the instrument is treated as feminine: *violina*.

Cartesius in *Compendio Musico*] The words in italics are with some small changes, just as Vallerius indicates, quotations from Descartes (1978, p. 34 ff.):

... ut semper semitonium majus habeat utrumque juxta se tonum majorem, item et tonus minor, cum quo scilicet hic ditonum componat ... ut scilicet harum fractionum auxilio idem tonus major quodammodo mobilis fiat ... tam exigua est differentia inter 480 & et 486, ut illius termini, qui ab utroque constituitur, mobilitas non perceptibili dissonantia auditum feriat.

Somewhat later in the compendium, in the chapter on dissonances, Descartes writes (1978, p. 54):

... tam exiguum est schismatis intervallum ut vix auribus possit discerni, ideo illae ex consonantiis, quarum sunt proximae, suavitatem mutantur: neque enim consonantiarum termini ita consistunt in indivisibili, ut si unus ex illis aliquantulum immutetur, statim omnis consonantiae suavitas pereat.

Mersennus, lib. 6, Prop. 7] The heading of proposition 7 in book 6 of Marin Mersenne's *Harmonicorum libri* (1648, p. 92) is: 'to define when a major tone should be placed between UT and RE, and a minor between RE and MI' (*Definire quandonam Tonus maior inter UT et RE, et minor inter RE et MI collocari debeant*). Thereafter we read at the beginning of the main text: 'it is not necessary that the minor tone, or the major, are established in the same places' (*Non est necessarium ut tonus minor, vel major in iisdem locis statuantur*), whereafter the subject is further treated. In the first corollary following the proposition, the discussion is summarized: 'from this it is evident that a musician can be forced to produce a minor tone, or major, wherever we want' (*Ex quibus manifestum est Musicum cogi posse, ut Tonum minorem, vel maiorem ubicumque voluerimus, faciat*). As we can see, Vallerius has rearranged the quotations into a new sentence, in which the longer passage in Mersenne has been outlined.

However, the final sentence in the passage from Mersenne has been taken almost literally from proposition 25 of book 6, which aims at placing the cardinal notes and consonances of the twelve modes in the proper places, just as indicated by Vallerius within the parenthesis. There we read (1648, p. 109): *Neque enim si feceris Tonum maiorem ab F ad G, eundem facies a G ad F, sed minorem.*

112. **Instrumentis ... indivisis]** Referred to in this context are the instruments of the viol and violin families which do not have frets, and which therefore are ‘undivided as regards their musical intervals’. In Vallerius / Bergrot (1717, p. 29) the same kind of instruments are called *infinita*, while those with frets are *finita*.

tubam ductilem] Walther simply translates it as a *Posaune* (cf. *GMO*, s.v. *tuba ductilis*; and *MGG*, vol. 7, cols. 1730 ff.). In thesis 116 below, Vallerius himself gives the Swedish translation *Basun* (cf. Hülphers 1969[1773], p. 85). Mersenne, however, gives the sackbut the Latin designation *tuba tractilis* (Mersenne 1648, pp. [ii]110 f.).

dulcinorum] The name of the instrument is attested in medieval Latin, albeit as a feminine (*LML*, s.v. *dulcina*). We also find the feminine still in Vallerius / Bergrot (1717, p. 27). Walther (s.v. *Dulcino*), however, translates it as *dulciana* and *dulcian*, and also renders its Latin name as *dulcisonans*. He explains it as *ein Blas-Instrument oder kleiner Basson, welcher sonst auch ein Quart-Fagott heisset, und mit den Frantzösischen Tailen und Quint-Hautbois übereinkommt* (cf. *GMO*, s.v. *dulcian* (i), and Praetorius 1619, II, p. 38). For Kircher, the *dulcinum* and *fagottum* are apparently considered as equivalents (1650, vol. 1, pp. 500 and 505; cf. Hülphers 1969[1773], p. 87).

buccinarum] The word basically refers to a kind of horn, used by shepherds or in military campaigns (cf. *OLD*, s.v. *bucina*). Walther, however, says that it can refer to trumpets in his time, and that some authors even translate it with *Posaune* or, as probably in our case, *Zincke* (cf. Praetorius 1619, II, pp. 2 and 35). In Mersenne (1648, pp. [ii]102 f.) *buccina* is seemingly equivalent to the *cornu venatorium* (‘hunting horn’).

Regalia] Cf. the comment on *Regal* in thesis 70 of *De sono* above. Here the word is in Latin in the neuter plural.

lyrae mendicorum, ut Nyckelgijga / Långspeel] We see here what kind of instruments Vallerius associates with the *lyra mendicorum* (literally ‘lyre of beggars’). Otherwise, it sometimes refers to the hurdy-gurdy (Kircher 1650, vol. 1, p. 487 [with picture VIII]; Hülphers 1969[1773], p. 83 [*lyrae rusticae*]; Adams, s.v. *lyra mendicorum*; and Apel 1972, p. 496. As regards the hurdy-gurdy’s change in the Middle Ages from courtly culture to the lower stratas of society, see *GMO*, s.v. *hurdy-gurdy*, 1).

For the *Nyckelgijga* (keyed fiddle), see the comments on thesis 103 above. *Långspeel*, however, is the *hommel*, or *Hummel* in German, designating a ‘partly fretted box zither’ (*GMO*, s.v. *Hommel*), which is used in Scandinavia, the Low Countries and some regions of Germany (on which see further Walin 1952).

Cijthararum] Praetorius (1619, II, p. 54) translates the word simply as a *Cithar* (‘cittern’), while also stating that it designated the harp in antiquity (cf. *LML*, s.v. *cithara*; Hülphers 1969[1773], p. 81; *GMO*, s.v. *cittern*; *MGG*, vol. 2, cols. 886 ff; and Mersenne 1648, pp. [ii]7 f.).

harpas] The word, from the Greek ἄρπη, first occurs in late Latin (Blaise [1], *TLL*). Walther (s.v. *arpa*) states that they are of three different kinds: the *harpanetta*, the *harpa gemina*, and the Irish harp (cf. Praetorius 1619, II, p. 56, where they are divided in a similar way; Vallerius / Bergrot 1717, p. 24; Hülphers 1969[1773], p. 81; and *MGG*, vol. 4, cols. 72 ff.).

pandoras] According to Praetorius (1619, II, pp. 53 f.), the *pandora* was perhaps similar to the πανδοῦρα of the Greeks, albeit not the same. The instrument of his time, he claims to be an English invention (from 1562) that almost looked like a large citter (cf. Walther, s.v. *pandura*; Hülphers 1969[1773], p. 81; *GMO*, s.v. *bandora*; and *MGG*, vol. 5, cols. 964 f.).

clavaria] In Walther (s.v. *claviatura*) the Latin word *claviarium* is explained as *diejenigen aus Holtz, Knochen oder Helffenbein gemachte Stücke eines Clavichordii, Clavizimbels, Orgel, u. d. g.* In Mersenne (1648, p. [ii]66) we likewise find the spelling *claviarium* (*Abacum seu Claviarium pinnarum*), and that is also the case in Kircher (1650, vol. 1, p. 454): *Abacus harmonicus, sive claviarium, vel ut Itali vocant tastatura*. Cf. the comments on *claver* in thesis 26 of *De sono* above.

Clavicymbala] The word refers to the harpsichord. Walther (s.v. *Cembalo*) explains it as *ein langes, und in Form eines Flügels besaitetes Schlag-Instrument, mit tangenten versehen*. For early occurrences of the word in Latin, see *LML*, *DMLBS* and *LLNMA* (cf. Praetorius 1619, II, pp. 62 f.; Mersenne 1648, pp. [ii]58 ff.; Vallerius / Bergrot 1717, p. 23; Hülphers 1969[1773], p. 80; *GMO*, s.v. *harpsichord*; and *MGG*, vol. 2, cols. 487 ff.).

Spinettae] Walther explains the word as *ein kleines Clavicymbel*, i.e. ‘a small harpsichord’ (cf. *GMO*, s.v. *spinet*; *MGG*, vol. 2, cols. 487 ff.; Vallerius / Bergrot 1717, p. 23 [*spinettum*]; Hülphers 1969[1773], pp. 79 f.; Hoven, s.v. *spinetum*; Bartal, s.v. *spinetum*; and Latham, s.v. *espineta*). *Spinetta* is also the Latin name given in Praetorius 1619, II, p. 62.

symphoniae] The word *symphonia* was used about a musical instrument as early as in Isidore of Seville (Blaise [1]), and was later in associated with the hurdy-gurdy in particular (*GMO*, s.v. *symphonia* (ii), cf. *MGG*, s.v. *symphonia*, II, 2; Mersenne 1648, pp. [ii]9 and 55 f.). Praetorius (1619, II, p. 62), however, used it on a group of instruments consisting of harpsichords, virginals and spinets, i.e. string keyboard instruments, and that is evidently also how Vallerius understood it (cf. Vallerius / Bergrot 1717, p. 22; and Hülphers 1969[1773], pp. 79 f.).

(vulgo Baassviol)] See the commentary on *violis majoribus* in thesis 80 of *De sono* above.

apud Cartesium, Vol. 3, Epist. XCV] The letter referred to, where Descartes accounts for his *systema ad faciendum instrumentum* (‘system for making an instrument’), can be found in his *Epistolae* (1683), vol. 3, pp. 386 f.

113. **Kircher *Musurgia*, l. 3, p. 101 ... Lib. 6, p. 447]** Vallerius's references to Kircher's *Musurgia universalis* (1650), book 3, p. 101; book 4, p. 178; book 7, p. 649; and book 6, p. 447, can all be easily verified.

Mersennus lib. 6, Prop. 6 ... tonus minor] The passages referred to, which thus treat the positions of the major and minor tones, can be found in Mersenne's *Harmonicorum libri XII* (1648), pp. 91 f., and 106 f.

quae habet Prop. 25] The proposition referred to, in Mersenne's *Harmonicorum libri XII* (1648), pp. 109 ff., has the heading *Cardinales duodecim vulgarium Modorum notas, et Consonantias propriis locis figere* ('to attach the cardinal notes of the twelve common modes and their consonances to the proper places'), and contains a table, with a following explanatory discussion, of the six arithmetic modes, which shows how these are distinguished by the different locations of the major and minor tones.

Milliet ... quem vide Tom. 3, tract. 22, Prop. 11.] In the *Cursus seu mundus mathematicus* (1674) of Milliet Dechales we find the passage referred to in vol. III, pp. 15 f.

114. **Milliet, Prop. 34 ... Ita Prop. 36]** Both quotations are taken, with some slight changes of numbers and moods, from Milliet Dechales's *Cursus seu Mundus Mathematicus* (1674), vol. III, pp. 39.

(vulgo mordanter)] In *GMO* (s.v. *mordent*) the ornament is described as consisting of 'the rapid alternation of the main note with a subsidiary note a step below' (cf. *MGG*, vol. 9, cols. 1444 ff.). Walther (s.v. *Mordant*) suggested that the word must derive from the Latin *mordere* (bite), since that was what this ornament sounded like. Andreas Orostander would in his primer later characterize it as a technical term among organists (Lundberg & Sjökvist 2010, p. 72). The preceding words *tremuli illi digitorum*, however, admittedly sound closer to a vibrato than to a mordent in our time.

115. **(vulgo Chormessig)]** As we can see, the vernacular term, which means 'in the manner of a choir (or a consort)', corresponds in sense to the previous *concentus universalis*. It is not unlikely that Vallerius with the latter words actually created a new multiword Latin term, which he also uses further below without the clarifying vernacular addition. The *concentus* is here understood as 'consort' in the sense of 'accord or harmony of several instruments or voices playing or singing in tune' (*OED*, s.v. *consort*, 3, a). In thesis 36 of *De sono* above, Vallerius for the same feature instead used the Latin phrase *consonantia instrumentorum communis* (see the commentary).

116. **tibias militares]** In Kircher's account of wind instruments (1650, vol. 1, p. 500), the *fistula militaris* differs from other flutes by the fact that it is held to the lips obliquely (*in transversum*).

Mersenno ex lib. 6, Prop. 26] The quotation is taken literally from Mersenne's *Harmonicorum libri XII* (1648), p. 110, where he discusses the names and the properties of the modes, and which instruments accordingly suit them.

(vulgo Trumpett)] The Swedish word in the parenthesis is simply 'trumpet', but Vallerius here primarily associates it with the war trumpet (cf. Vallerius / Bergrot 1717, p. 26). In thesis 39 of the previous dissertation *De sono* above, which he also refers to, the war trumpet is primarily used for designating a natural trumpet.

(vulgo Trumpetstycken)] Once again Vallerius uses a word in the vernacular, meaning 'trumpet pieces', in order to add precision to a Latin word (*cantilena*), which does not express the intended sense well enough.

(vulgo Basun)] According to Vallerius here, the Swedish word at this time thus refers to the sackbut (cf. Vallerius / Bergrot 1717, p. 23; and Walther, s.v. *Posaune*). In Swedberg, however, the word is translated as *tuba*, *buccina*, *buccinum*.

Legionis Praetoriae] While *legio* at this time means 'regiment' (Helander 2004, p. 184), *praetorius* is in JPG explained as *fougde eller feltherre tilhörig ... Das zu den schultheyssen gehört*. Here the phrase refers to 'lifeguard regiment' (cf. Helander 2004, p. 187).

117. **Musices]** The word *musica* in general lexica of the time has the transcribed Greek *musice* as a parallel form (e.g. JPG and BFS, Matthiae). When the latter is used, it also follows the Greek morphology, here being in the genitive singular.

118. **transpositione]** The word is late Latin (Blaise [1], Souter). Neither Krebs & Schmalz nor Noltenius have reacted against it, and the former even mentions it as an exemplary word (s.v. *transmutare*). In a musical context, it first appears in the Middle Ages (cf. *LLNMA*, s.v. *transpositio*, c), e.g. in the *Musica enchiriadis* (1981, p. 36, among others). As regards the transposition of modes in general, cf. e.g. Kircher 1650, vol. 1, pp. 231 ff., and Burmeister 1993[1606], pp. 134 ff. See further Braun 1994, pp. 92 ff.; and Barnett 2002, pp. 412 f. and 427 ff.

per varium nervorum concentum (vulgo förstämningh)] We see again how Vallerius struggles with the Latin translations of concepts he is only familiar with in the vernacular, and seemingly he thereby also invents a new multiword Latin term. The *varius nervorum concentus*, which he explains as *förstämmingh*, is in German *Verstimmung*, while English uses the Italian *scordatura*. It designates 'a tuning other than the normal, established one' (*GMO*, s.v. *scordatura*, cf. *MGG*, vol. 8, cols. 1218 ff.). In the dissertation *De tarantula* (1702, p. 26), defended under Vallerius's presidency, the same Latin term is used for the *scordatura*.

119. **Kircherus ... *Musurgia* enim, lib. 8, p. 51, ... Pag. 62 ... pag. 63]** As Vallerius tells us, the references are all to different pages in Kircher's *Musurgia universalis* (1650), and this is easily verified. In vol. 2 on p. 51 of that work we find a picture of Kircher's tonographic table. And while the last quotation is taken literally from a heading on p. 63, where Kircher in a table suggests a general system for changing a theme taken up according to the twelve tones, the second section in italics is rather a summary of what is contained on pp. 62 f.

Mensam, ut vocat, tonographicam generalem] As Vallerius indicates, the matter referred to is an invention by Kircher. So is perhaps the adjective *tonographicus*, which could not be attested in other Latin sources. The coinage is very typical both of Kircher and of the neologisms in scientific Latin prose at the time, as it is made up of two different Greek stems, viz. *τόνος* and *γραφικός*. The richer vocabulary of Greek, as well as the easier creation of new words in this language, were two crucial reasons for using it (see further Helander 2004, pp. 69 ff.).

120. **Haec adducit Kircherus]** Vallerius has taken the words in italics that follow from the preface of book 8 of Kircher's *Musurgia* (1650), vol. 2, pp. 1 f., which explains that the book shall treat the art of composition. He has picked out sentences from different parts and given them a new arrangement, with some slight alterations when necessary. The words until *pertingere possint* are all from the heading of the chapter. The rest is from different sections of p. 2. The subject of book 8 of the *Musurgia* is Kircher's newly invented musarithmetic art, with the aid of which everyone would be able to compose music.

per Arcam (ut vocat) Musarithmicam] Just as in the thesis above, Vallerius here refers to a new invention by Kircher. The musarithmetic box, by which everyone can compose music mechanically, is treated in book 8 of the *Musurgia* (1650, vol. 2, pp. 185 ff.), in connection to which pages it is also depicted. The adjective *musarithmicus*, from the Greek *Μουσική* and *ἀριθμός*, is likely to be Kircher's own coinage, just as are many other words of this kind, and that which was said above on *tonographicus*, as regards the Greek element in new words at this time, holds true also in this case. Kircher himself in the *Musurgia* defines *musarithmus* as (1650, vol. 2, p. 53) 'a conglomerate of sonorous numbers, which is very suitable for expressing harmonious periods' (*numerosum sonorum congeries harmonicis periodis exprimendis aptissima*).

Melotacticas] The adjective is probably Kircher's own coinage as well, made up by the Greek *μέλος* (tune) and the Latin *tactus*.

simplices] This and the following term in the enumeration are all musical *termini technici*, designating different compositional devices. The word *simplex* here in practice means 'monophonic', in accordance with the

- definition of *Tinctoris* (s.v. *cantus simplex*; cf. *GMO*, s.v. *simplex*, 1). Walther (s.v. *canto semplice*) even explains it as *Choral-Gesang*.
- compositas**] The *compositus* is thus ‘polyphonic’ (*LML*, s.v. *compositus*, 5; *Tinctoris*, s.v. *cantus compositus*; cf. *GMO*, s.v. *cantus* (i)).
- floridas**] The Latin term, just as *florid* in English, refers to ornamented melody. Walther (s.v. *Fiorito*) describes it as *geputzt, geschmückt, d. ist mit allerhand Löfflein gezieret* (cf. *LML*; *GMO*, s.v. *florid*; and *MGG*, vol. 4, cols. 553 ff.). In Kircher it is used as a synonym of *diminutus* (1650, vol. 1, p. 242). See also the commentary on *Musica diminuta* in thesis 68 of *De sono* above. In Bellman / Vallerius (1706, p. 42) *floridus* is explained by the statement that the ‘florid counterpoint modulates quantities of different shapes above the notes of the plainsong’ (*contrapunctus ... Floridus vero variarum figurarum quantitates super notulas plani cantus modulatur*).
- syncopatas**] In *Tinctoris* (s.v. *sincopa*) it is *alicuius notae interposita maiore per partes divisio* (‘a division of a note into parts by an interposed larger note’). Walther (s.v. *syncopatio*) likewise explains it as *eine wieder den Tact angebrachte Rück-oder Zertheilung einer Note, so ein semibrevis, Minima oder semiminima seyn kan* (cf. *OED*, s.v. *syncopation*, 3, a).
- ligaturis**] The ligature is explained by *Tinctoris* (s.v. *ligatura*) as *unius notae ad aliam iunctura* (‘the joining together of one note to another’). In Vallerius’s time, however, it had long since been without any practical use, for the most part only being ‘a scribal flourish, a more elegant way of writing notes’ (*GMO*, s.v. *ligature* (i)). We should thus probably understand it here primarily as a ‘group of tones’.
- fugarumque**] As will be remembered, *fuga* in Latin means flight (*sese insectantes*). Walther (s.v. *Fugha*) thus explains it as *ein künstlich Stücke, da eine Stimme der andern, gleichsam fliehend, mit einerley themate, in verschiedenen Tone nacheilet*, while Kircher describes it as ‘a successive repetition and artful distribution of one and the same cadences in different parts of the song’ (*unius et eiusdem clausulae in diversis cantilenae partibus successiva quaedam repetitio et artificiosa distributio* [1650, vol. 1, p. 368]). In the section on musical rhetoric, Kircher also claims that the fugue is a ‘harmonical period that is suitable for words that indicate flight’ (Kircher 1650, vol. 2, p. 145). The word *fuga* was at first (from the 14th century) primarily used in the sense of ‘canon’, but was with time applied to several kinds of imitative counterpoint (*GMO*, s.v. *fugue*; cf. *LML*, s.v. *fuga*; *MGG*, vol. 3, cols. 930 ff.; *HMT*, s.v. *fuga*; and Braun 1994, pp. 269 ff.).
- harmonices**] While in ancient Latin *harmonia* refers to harmony itself, and *harmonice*, from the Greek ἀρμονική, rather to the theory of music (cf. *OLD*), the latter is here obviously used in the sense of harmony. In medieval Latin we find that *harmonice* is used in both these senses (*LML*, s.v. *harmonica* (*harmonice*), 3). In Walther (s.v. *harmonica*) the ancient

definition prevails again in the explanation of *harmonice* as *die Wissenschaft, wie die Töne sich gegen einander in ihrer Ordnung und Grösse verhalten*. However, the form *harmonice* could not be attested in general dictionaries of the time consulted during this work, but as with *musices* above, it naturally followed Greek morphology.

Arcae Musarithmicæ ... copiam mihi fecit Daniel Caméen] Daniel Caméen was born in Karlstad in 1625 as the son of the ecclesiastical superintendent in the same town. He matriculated at Uppsala university in 1644 and won his master's degree in 1652. After travels and studies abroad, in Stockholm he became, among other things, counsellor (*rådman*), associate judge of appeal (*hovrättsassessor*), and chief magistrate of justice (*justitieborgmästare*). The latter position he held from 1683. He was later ennobled in 1687. He died in 1692, and was buried in Stockholm Cathedral (*Stockholms rådhus och råd* 1915, pp. 47 f.; Gren 2000, pp. 97 f.; *SBL*, s.v. *Caméen*).

Although the copy of Kircher's *arca musarithmica* mentioned here is probably no longer extant, others certainly are. One such was, for instance, once owned by Samuel Pepys and is now kept in the Pepys archive in Cambridge (Wardhaugh 2008, p. 25). A digitized version of an *Arca musarithmica* can be seen and investigated on the Internet at <http://diglib.hab.de/wdb.php?dir=varia/objekte/90-aug-8f>.

ciphras] This Arab word is first attested in Latin in the Middle Ages (Blaise [2], s.v. *cifra*; *DMLBS*, s.v. *cifra*), where it originally had the sense of 'zero', but later also 'numeral' (Solvang, s.v. *siffer*). Noltenius (cols. 38 and 461) thus translates it as *eine Ziffer*, being spelt both *cifra* and *zifera*, but rejects it in favour of expressions such as *numeratorum notae* (see further Helander 2004, p. 146).

pinnulis] Admittedly, the translation here is questionable. Kircher does not use this word, and since we do not know exactly what Vallerius's musarithmic box looked like, but have to rely on Kircher's description and the picture in the *Musurgia*, a conjecture is necessary. It seems that the function of Vallerius's *pinnula* corresponds to Kircher's (1650, vol. 2, p. 185) *chartacea virga* ('stick of paper') or *lignea virga* ('wooden stick'). Vallerius's choice of a different word could then simply depend on how his own box was constructed. As regards the sense of 'stick', cf. e.g. Latham, s.v. *pinna*, and JPG, s.v. *pinnula*, 2.

sit in iudicio quam fuit in perceptione] See the comments on thesis 101 above.

121. motus excitare secundum variam suam profunditatem] The importance of pitch for raising affects is similarly stressed in Kircher, who states that 'the cause of a different excitement of the affects is nothing other than a different principle of the spirit that is differently incited de-

pending on the different degrees of the harmonious motion of high and low pitches that are impressed in the air' (1650, vol. 1, p. 568):

... patet causam diversae concitationis affectuum aliam non esse, nisi ... diversam spiritus rationem pro diversis intensionis et remissionis motus harmonici gradibus in aere impressis aliter incitatum.

Tenore] Having had several different meanings in the earlier history of music, the word came to refer to the 'holding' voice in older polyphony, in relation to which the other voices were calculated. From the 15th century onwards it was especially used for male voices singing this part, and then both to singers and to instruments in the register from c to a¹. (*GMO*; cf. *MGG*, vol. 8, cols. 1780 ff.). Walther (s.v. *tenore*) accordingly defines it as *unter den vier Sing-Stimmen die dritte*. Descartes says that this part 'contains the subject of the entire modulation, and is like the nerve in the middle of the body of the entire song, which holds up and unites its remaining limbs' (1978, p. 60):

... continet enim subjectum totius modulationis, et est veluti nervus in medio totius cantilenae corpore, qui reliqua ejus membra sustinet, et conjungit.

Kircher writes that the third part is called *tenor*, and *mesodos* in Greek. It has its name from *teneo*, since it seems to hold the melody, when it proceeds with constant pace in the middle between high and low intervals (1650, vol. 1, p. 218). In Bellman / Vallerius (1706, p. 41) it is called *tenor* or *media vox*.

Cantu] The word was used in several ways from the antiquity and onwards, often for the melody, but in the broadest sense even referring to music itself (cf. *LML*, but also Tinctoris: *Cantus est multitudo ex unisonis constituta*; and Walther: *actus canendi*). From the second half of the 16th century, it was mostly used for the top voice in polyphonic music (*GMO*, s.v. *cantus (i)*; cf. *MGG*, vol. 8, cols. 1777 ff.). Descartes, who calls this part *superius*, says that 'it should advance most of all along the steps' (1978, p. 62: *maxime per gradus debet incedere*). Kircher, however, who calls the part *cantus*, adds within a parenthesis that it can also be called *discantus* and *superior* in Latin, or *soprano* in Italian, *hautcôtie* in French, and *netodus* in Greek (1650, vol. 1, p. 218). In Bellman / Vallerius (1706, p. 41) it is called *cantus* or *discantus*.

Basso] The word is attested in medieval Latin in the sense of 'low', and was even then used for the lowest voice in a polyphonic composition (*LML*). Walther explains it as *Bass-Stimme*, *Grund-Stimme*, and this also indicates the influence from the concept of *basis* (foundation). The latter word was also used on the lowest voice, but was generally displaced by *bassus* during the Renaissance (*GMO*, cf. Walther, s.v. *basis*; and *MGG*, vol. 8,

col. 1796). Descartes says of it that ‘it should fill the ears most of all, since the other parts adapt to it especially ... it usually advances not by steps, but even by skips’ (1978, p. 60):

... maxime aures implere debet, quia omnes aliae voces illam praecipue respiciunt ... non per gradus, sed etiam per saltus solet incedere.

In Kircher (1650, vol. 1, p. 218) the fourth part is called *basis*, followed by the remark *vulgo Bassus, Graecis hypatodus* (from ὑπάτη [‘the upper string that was lowest in pitch’] and -ώδης). In Bellman / Vallerius (1706, p. 41) it is called *bassus* or *gravis vox*, but it is also stated that the designation *barytonans* can be used.

Bassetto] The word, which is originally an Italian diminutive, in the definition of Praetorius refers to a typically Baroque feature ‘the lowest voice in a high-register chorus, which executes the fundament and whose structure resembles a true bass’, i.e. it is the lowest voice in compositions where there is no bass part (*GMO*, s.v. *Bassett (i)*).

Alto] The word from the middle of the 15th century referred to the voice below the *cantus*, as an abbreviation of *contratenor altus* (*GMO*, cf. *MGG*, vol. 8, cols. 1782 ff.). Walther (s.v. *alto*), however, claims that the name comes from its height, *weil sie ... dem Discant sehr nahe kommt, und mehr Claves aus dieses, als aus des Tenors seinem Systemate annimmt*. Descartes, however, calls this part *contra-tenor*, and says that it is used ‘for pleasing by its variety by advancing in contrary motions ... it usually advances by skips, just like the bass part’ (1978, p. 62):

... ut contrariis motibus incedendo varietate delectet ... Solet, ut Bassus, per saltus incedere.

Kircher calls the second part *altus*, and adds that in Greek it can be called *paranetodus* (from παρανήτη [‘the string below the νήτη’] and -ώδης) or *contratenor*. The latter of these he explains by stating that this part is rarely in concord with the *tenor*, and that it is usually a fourth above it (1650, vol. 1, p. 218). In Bellman / Vallerius (1706, p. 41) it is called *altus* or *tenor acutus* or *contratenor*.

122. Concludimus itaque ...] The obvious conclusion is that music’s potency of rousing the affects should not be ascribed only to the modes, but to many other aspects of music. Descartes, however, on the one hand associated this potency with the modes, as we saw above, on the other he did not ascribe it to the modes in themselves. At the end of his writing he thus concludes that a treatment of the power of music on the affects should show by what steps, consonances, times, and similar phenomena these are

roused. It would, though, exceed the plan of his compendium (1978, p. 68):

... jam quidem sequerentur ut de singulis animi motibus, qui a Musica possunt excitari, separatim agerem, ostenderemque per quos gradus, consonantias, tempora, et similia debeant illi excitari, sed excederem compendii institutum.

In the dissertation *De tarantula* (1702), defended under Vallerius's presidency, the aspects of music that are especially important for rousing the affects are summarized more specifically, viz. 'the kind of style, the position of the consonances and their transition from one to another, the correct application of *arsis* and *thesis*, the specific positions of the dissonances, and the suitable location of semitones and cadences, and finally the entire musical rhythm' (p. 22):

... attendere debemus varium styli genus, consonantiarum positionem et transitionem ab una in alteram, arsis ac thesis justam applicationem, dissonantiarum certas sedes, semitoniorum ac cadentiarum commodam collocationem, totumque demum Rythmicum Musicum.

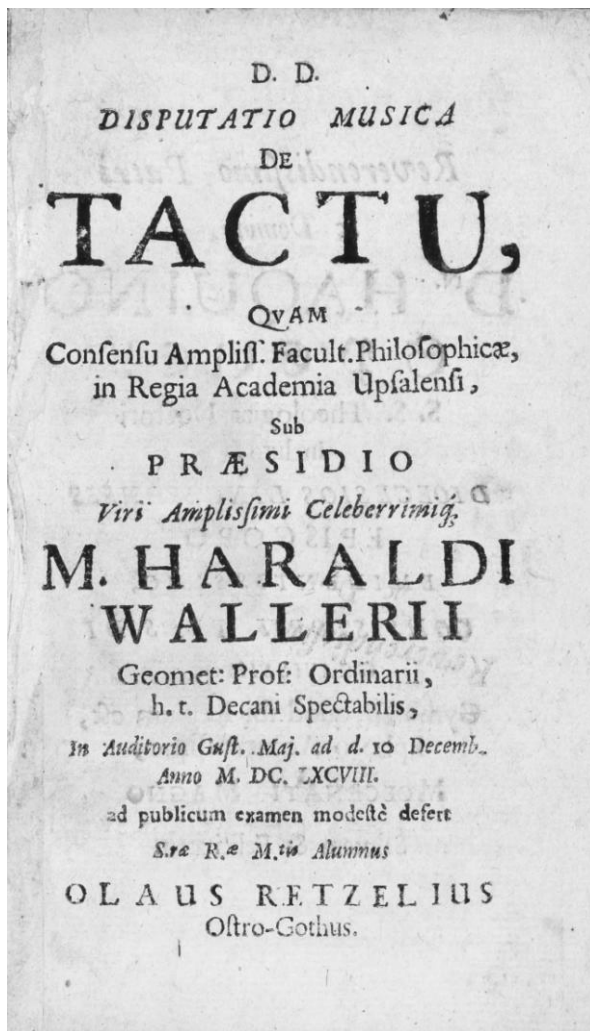
ut in sequentibus patebit] This phrase in the very last thesis of the dissertation clearly points towards following studies in music theory on Vallerius's behalf. It is even hinted that we in those studies will meet the real causes of the power of music to rouse the affects. Eventually, the *De tactu* dissertation came about in 1698, and considering the information here we could safely assume that Vallerius had planned such a study from early on. The following 'problem' could thus be regarded as an appetizer on that subject.

Corollary

animi causa] See first the comments on the *corollaria* of the *De sono*-dissertation above. In the case here, it is even explicitly stated that the aim of this postponed problem is riddle-solving, and even diversion. But at the same time, as we saw above, Vallerius apparently alludes to the subject of the next study in music theory, by introducing questions pertaining to musical *tactus*.

4 *Disputatio musica de tactu*

4.1 Text and Translation



Deo Duce.

DISPUTATIO MUSICA

DE

TACTU,

QUAM,

Consensu Amplissimae Facultatis Philosophicae

in Regia Academia Upsalensi,

Sub

PRAESIDIO

Viri Amplissimi Celeberrimique

Magistri HARALDI

WALLERII,

Geometriae Professoris Ordinarii,

hoc tempore Decani Spectabilis,

In Auditorio Gustaviano Majore ad diem 10 Decembris

Anno M. DC. XCVIII.

ad publicum examen modeste defert

Sacrae Regiae Majestatis Alumnus

OLAUS RETZELIUS

Ostro-Gothus.

Under the guidance of God.

A musical disputation
on
tactus,
which,
with the consent of the most renowned philosophical faculty
at the Royal Academy of Uppsala,
under
the presidency of
the most renowned and distinguished man
Master Harald
Vallerius,
professor ordinarius of geometry,
at this time honourable Dean,
in the *Auditorium Gustavianum majus*
10 December 1698,
Olaus Retzelius
from Östergötland,
holder of his Holy Royal Majesty's scholarship,
modestly delivers to public examination.

Reverendissimo Patri
ac Domino,
Domino HAQUINO
SPEGEL,
SacroSanctae Theologiae Doctori
Incluto,
DIOECESIOS LINCOPENSIS
EPISCOPO
EMINENTISSIMO,
CONSISTORII PRAESIDI
GRAVISSIMO,
Gymnasii, quod ibi Regium est,
Ephoro Accuratissimo,
MOECENATI MAGNO
Salutem et Felicitatem.

To the Right Reverend Father
and Lord,
Haquin Spegel,
renowned Doctor of
sacrosanct theology,
most eminent
Bishop
of the diocese of Linköping,
most honourable
praeses of the consistory,
most diligent supervisor
of the Royal *gymnasium*, which lies there,
my great patron,
well-being and happiness.

Reverendissime Pater.

Ut sub auspicio alieno scriptum hocce meum in publicum prodiret, summa, qua laborat, tenuitas efflagitavit. Sed ut Tui splendorem Nominis auderet mutuari, Favor ille maximus, quo bonis omnibus prodesse studes, serena fronte invitavit. Quicquid enim bonitatis, quicquid subsidii Humanitas Tua habet, habet autem plurimum, id tuendis et evehendis literarum cultoribus totum Te impendere constans et amplissima fama est. Scilicet jure quodam Musae id requirere videbantur, ut Antistiti suo Eminentissimo alumnos singulos singulariter commendatos cernerent, nutantibusque eorum fortunis paratissimum in eo fulcimentum invenirent. In Te itaque, Reverendissime Pater, certissimum suis praesidium invenisse impense sibi gratulantur. Laetos a Te abeuntium vultus quotidie intuentur, et aspectu tam jucundo nova semper gaudia gaudent. His, inquam, ego fretus Generosae mentis indiciis Reverendissimum Nomen Tuum exercitio huic meo, ut ut rudi ac impolito, praefigere audeo, non ut dignitatis illi opinionem tam Illustri Titulo conciliare velim – scilicet et id saepe fieri solet – sed ut venerabundae mentis signum etiam publice sic declarem. Patiari itaque, Reverendissime Pater, ut conatus hicce meus chartaceo munere comprehensus coram Te deponatur, nec sua ex tenuitate, sed animo offerentis, utpote observantiae pleno, existimetur. Deum ego, omnis boni fontem, pro incolumitate Tua perenni et continua felicitatum serie assiduis precibus venerabor, ut non nisi post longissimam hujus vitae usuram de coetu Christi in his terris optime meritis ad beatissimam coelestium societatem felix tandem demigres! Sic sincerus opto,

Reverendissimi Nominis Tui

Cultor Humillimus

Olaus Retzelius.

Right Reverend father.

That this writing of mine would appear in public under the auspices of another person, the very great poverty demanded, by which it is afflicted. But that it would dare to borrow the splendour of your name, the great favour of yours, with which you strive to help all good people, offered with a cheerful countenance. For whatever generosity, whatever assistance your humane character possesses, and it possesses much indeed, there is a constant and widely spread opinion that you spend it all on protecting and promoting the practisers of the literary arts. The Muses namely seemed to require it with some right, that they should see each and every pupil exceptionally well recommended for their most eminent bishop's favour, and that they should find a most vigilant support in him in their wavering fortunes. Therefore, Right Reverend Father, they eagerly congratulate themselves for having found a firmest protection in you. Every day they see the happy faces of those who leave you, and from a so delightful sight they experience a joy that is always new. Relying on this very evidence of your generous mind, I dare to attach your Right Reverend name to the beginning of this exercise of mine, however ignorant and unrefined it may be. Not that I with a so illustrious dedication would like to attach a notion of dignity to it – of course also this happens often – but I do it in this way in order to also publically demonstrate a sign of my revering mind. Allow therefore, Right Reverend Father, that this endeavor of mine, which is comprised in a gift of paper, be laid down in front of you, and that it be not judged by its thinness, but by the intention of the one who offers it, since this is full of observance. With prayers I shall constantly entreat God, the source of all goodness, for your everlasting well-being and continuous successive good fortunes, so that you finally depart happily, only after a very long enjoyment of this life, with splendid merits from the company of Christ in this world to the blessed heavenly community! So I wish sincerely,

your Right Reverend name's
most humble follower
Olaus Retzelius.

CUM DEO.

Thesis I.

Inter voluptates, quibus animum nostrum ope sensuum frui Optimus DEUS voluit, an ulla major sit ea, quae per aurium usum venit, haud facile dixerimus, quoniam nec cetera sensationum organa, si modo visum excipias, tot simul objectorum distincte recipiendorum capacia deprehenduntur, nec quae in illis habentur delectationes tantam in commovendis spiritibus vim, quantum auditu percipimus, habere possunt. Scilicet objectum auditus, seu sonus, quotquot organo inserviunt fibrae, eas simul omnes afficit idque in utraque aure aequaliter, cum in reliquis sensibus singula tantum nervorum filamenta illorum ministerio destinata commoveantur. Unde manifestum est majorem ex totius organi agitatione quam ex aliqua ejus parte mota in spiritibus animalibus discursum oriri. Id vero prae aliis ex Musicae effectibus prorsus eximiis patere neminem inficias iturum hoc certius nobis persuademus, quod etiam immanes saepe bestias cantu ita flexas, ut indomitum robur summum hominibus domandum mansuetiores exhibuerint, non paucas invenire liceat. Quamobrem, si circa soni considerationem paululum versemur, non defuturum operae pretium existimamus, etsi non nisi unam ejus affectionem, qui nostri ingenii modulus est, heic metiri cogitemus.

Thesis II.

Sonus extra sensationem nostram nihil aliud est quam tremulus corporis sonori et aeris motus ab externa vi excitatus. Ubi licet aquam et alios liquores subjectum, in quo sonus fieri possit, esse non negemus, tamen aerem, utpote ceteris longe mobiliorem, propriissimam et sono producendo maxime idoneam materiam judicamus. Hujus enim particulae plumularum instar ramosae et summe flexiles intelliguntur, ut non solum condensari et expandi facillimo negotio queant, sed etiam quibuscunque motibus recipiendis pares sint. Quod autem corporis sonori fecimus mentionem, id non ita acceptum volumus, quasi ad omnem sonum illud necessarium ducamus, ut corpus, quod vibrationes istas aeri imprimit, ipsum concutiat. Nam ut hoc in instrumento talibus vibrationibus apto ad continuationem soni plurimum facere fatemur, ita quam saepissime aerem ex sola ad corpus durum allisione pro varia hujus figura condensari et reflecti, atque sic tremulos ejusmodi motus vel undulationes accipere dicimus. Immo ipsas aeris particulas vento vel flamma agitatae atque inter se collisas absque ope corporis durioris sonum vel sibilum edere toto die percipimus. Sed de soni generatione agere non est

With God.

Thesis 1.

Among the pleasures, which Greatest God wanted our mind to enjoy with the aid of the senses, we could not easily tell whether there is any greater than the one that comes from the use of the ears, since neither are the other organs of sensation, provided that you make an exception for vision, found to be capable of perceiving so many objects distinctly at the same time, nor can the delights that can be found in them have such a great power to stir our spirits, as the one that we perceive with our hearing. For the object of hearing, or sound, however many fibres there are that serve the organ, affects all of them at the same time, and this to an equal degree in both ears, while in the other senses only every single filament of the nerves that is purposed for the function is agitated. Thereby it is evident that a greater activity comes about in the spirits of living beings from the agitation of an entire organ than from some part of it that has been moved. That this is more obvious than the others of the quite outstanding effects of music, we believe more surely that nobody shall deny because of this fact, that it is even possible to find not a few, often savage, animals that have been weakened in such a way from singing, that they have become more gentle and allowed their untamed strength to be tamed by men. For this reason, if we concern ourselves for a short while with a consideration of sound, we think that the reward of the effort shall not be absent, although we here plan to survey only one of its properties, according to the abilities of our intellect.

Thesis 2.

Sound outside of our sensation is nothing but a trembling motion of a sounding body and air, which has been stirred by an external force. Where it is possible we should not deny that water and other liquids are a subject in which sound can come about, but we are of the opinion that air, since it is much more mobile than the others, is the most appropriate and most suitable substance for the production of sound. For its particles are understood to be branch-like and very flexible just like small feathers, so that they can not only condense and expand very easily, but are even suitable for receiving all kinds of motions. But that we mentioned a sounding body we do not wish to be understood thus, as if we consider it necessary for every sound that the body, which presses these vibrations upon the air, is itself shaken. For just as we acknowledge that this contributes much to the continuation of sound in an instrument that is suited to such vibrations, we say how very often air is condensed and reflected only from a dash into a hard body, depending on its varying shape, and thus receives the trembles or undulations of this kind of motion. Yes the whole day we perceive that the very particles of air that are stirred by wind or fire and that collide with each other produce a sound or a whistling without the aid of a harder body. But to deal with the generation

instituti nostri. Qui eam videre desiderat, Mersennum *de Natura sonorum* adeat, vel si in compendium missam hanc doctrinam malit, elegantissimam Amplissimi Praesidis nostri *de Sono disputationem* consulat.

Thesis III.

Tria vero in sono invenimus, ad quae reliquae ejus affectiones sunt reducendae, *Longitudinem* nempe, *Latitudinem* ac *Profunditatem*. Vix enim quicquam in motibus istis tremulis seu vibrationibus aeris occurrit consideratione dignum, quod non horum aliquod respicit, cui innitatur. Verum ne tribus hisce vocabulis corpus aliquod introducere videamur, dicimus nos, non quemadmodum Physici solent, illa interpretari, siquidem sonus nihil aliud sit quam celerrimus quidam corporis motus, cujus determinationem aer vibratus nervorum quorundam in aure interventu animae percipiendam exhibet. Ideoque frustra triplicem istam corporis mensuram heic desideramus, nisi forte totum illud spatium, quod celerrimae istae aeris concussioniones occupant, sic metiri velimus. Quod tamen nos uno latitudinis vocabulo mox comprehendemus. Proinde quoties in hoc nostro scripto hae voces occurrunt, a consideratione corporis sic quidem abstractam Benevoli Lectoris cogitationem velimus, ut non nisi modum quandam illius secundum praecipuas suas differentias heic delineari existimet.

Thesis IV.

Per longitudinem itaque soni totum illud temporis spatium intelligimus, quo integra vibrationum vel undulationum periodus in corpore atque aere motis durat, vel si formalem soni significatum mavis, totum illud temporis intervallum, quo anima tremulos istos aeris recursus beneficio nervi seu pelliculae in aure percipit. Quod quidem singulis sonis certum definire nostri iudicii esse nequit, praesertim cum pro varia particularum in corpore sonoro atque aeris dispositione et diversitate vis moventis illud non possit non perpetuo variari, ut jam de eo, quod nullus sensus ultimas corporis concussioniones observare valeat, nihil dicamus. Mersennus lib. 2, *de causis sonorum*, prop. 30, cordam cannabinam 45 pedum et illius duplam duabus libris tensam centum recursus fecisse centum minutis secundis proxime aequales, eamque cum a libris $8 \frac{1}{3}$ tendebatur, eodem temporis spatio 200 recursus perfecisse, a se accurate observatum tradit. Sed hanc in omnibus et singulis corporibus proportionem investigare res esset magni et forsani irriti laboris, neque ea ad institutum nostrum pertinere videtur, quandoquidem in exercitio Musico vix nisi rarissime tantum temporis motae cordae tribuatur, quantum ipsa ad integram recursuum periodum requirere potest.

of sound is not a part of our undertaking. He who wishes to read about it, should go to Mersenne's 'On the nature of sounds', or if he prefers to see this theory in abbreviation, he should consult the very fine 'Disputation on sound' of our most renowned praeses.

Thesis 3.

We find three aspects in sound, to which its other properties must be traced back, namely *duration*, *volume* and *pitch*. For hardly anything that deserves consideration occurs in these trembling motions or vibrations of air, which does not relate to at least one of them, on which it depends. But lest we seem to introduce some kind of body with these three designations, we say that these are not interpreted in the same way as is usual by the physicists, since sound is nothing other than a very swift motion of a body, the determination of which air in vibration presents to the soul to be perceived by mediation of certain nerves in the ear. And therefore we here request this threefold measure of a body in vain, unless we perhaps want to measure in this way the entire space, which these very swift concussions of the air occupy. But this we shall soon comprise in the single designation of volume. Accordingly, as soon as these words occur in our writing, we want the thoughts of the benevolent reader to be so diverted indeed from the consideration of a body, that he thinks that only a certain mode of it is sketched out here in accordance with its special distinguishing characteristics.

Thesis 4.

With the duration of sound we therefore understand this entire space of time, during which a complete period of vibrations or undulations lasts in a body and air that have been moved, or if you prefer the formal signification of sound, that entire interval of time, during which the mind perceives these trembling movements of the air, thanks to a nerve or a skin in the ear. Certainly it cannot be up to our judgment to define this for certain in every single sound, especially since it cannot but vary endlessly, depending on the different dispositions of the particles in the sonorous body and of the air, and on the diversity of the moving force, just to say nothing about the fact that no sense can observe the last concussions of the body. Mersenne, in book 2, 'on the causes of sounds', proposition 30, relates that he had carefully observed that a chord of hemp of 45 feet and its duple that was stretched with two pounds produced one hundred movements that were almost equal to one hundred seconds, and when it was stretched with $8 \frac{1}{3}$ pounds, it completed 200 movements in the same space of time. But to investigate this proportion in all single bodies would be a matter of great, and perhaps ineffectual, labour. Neither does it seem to be a concern to our undertaking, since in musical exercise so rarely is such time granted to the chord that has been moved, as it can itself require for a complete period of movements.

In instrumentis vero pneumaticis statim atque ventus sufficiens defuerit, ipsum sonum necessario quiescere animadvertimus, siquidem heic nulla sit corporis moti vis, quae, quemadmodum in nervis fit, vibrationes semper novas formet.

Thesis V.

Latitudinis autem vocabulo sphaera illa maxima, intra quam sonus audiri potest, seu totum illud spatium nobis venit, per quod corpus aliquod motum suis prorsus similes aeri vibrationes imprimere valet. Cujus magnitudinem sphaerae vix quisquam est, qui determinare audet, quoniam, licet certissimum sit sonum, quo gravior ac fortior fuerit, hoc majores vibrationes habere atque adeo a majore loci intervallo audiri, tamen iis particulis aer saepe est infectus, ut tremulis ejusmodi vibrationibus minus aptus reperiatur. Et quanquam satis magna vis fuerit movens, tamen, nisi instrumentum habeamus justae capacitatis, frustra latitudinem soni vi moventi respondentem requirimus. Quae Mersennus, lib. 2, prop. 39, experimenta habet, illa e majoribus sonis desumpta sunt, quam ut Musicae considerationis esse possint. Quamobrem nec nobis heic usui futura existimamus. Neque sine maxima difficultate ille calculus fore videtur, si, ut magnus ille Musurgicus suadet, nervi alicujus dati sonum reliquorum sonorum mensuram statuere quis velit, siquidem is, quomodo ad datum nervum non solum ceterorum crassities et longitudo, sed etiam materiae soliditas, vis proportionata et plurima alia se habeant, perquam accurato examine elicere debeat. Musico certe ea circa hanc rem notitia sufficit, ut quando pro argumenti, quod canitur, varietate validius fides pulsandum vel vocem intendendum, aut etiam submissius agendum sit, rite noverit. Quam distinctionem Practici vocibus *Forte* et *Piano* aliisque similibus indicare solent.

Thesis VI.

Porro omnem circa acutum et grave sonorum varietatem sub Profunditate comprehendimus, adeo ut quicquid consonantiarum aut dissonantiarum in tota Musica observatur, illud ad hanc referri debere tuto statuamus. Unicum vero profunditatis et acuminis in sono fundamentum tarditas et crebritas vibrationum, quas corpus sonorum et aer faciunt, ab acuratissimis Physico-Musicis merito salutantur, ubi per crebritatem vibrationum non tam celeritatem cursus, quanquam et haec omnino sit necessaria, quam frequentiam illam, qua chorda jam mota extremitates suae sphaeroidis tangit, intellectum volunt. Si enim sola celeritas percurrendi spatium, quod est inter duo extrema, soni varietatem efficeret,

But in pneumatical instruments, as soon as there is no sufficient wind, we notice that the sound itself necessarily abates, since there is no force of a moved body here, which always creates new vibrations, just as it does in strings.

Thesis 5.

With the designation of volume we refer to that very big sphere, within which sound can be heard, or that entire space, through which some kind of moved body is able to press vibrations upon the air that are quite similar to its own. There is hardly anyone who dares to determine the size of this sphere, since, although it is very certain that sound has greater vibrations, the lower and stronger it is, and is thus heard at a greater distance, the air is often corrupted by such particles, that it is found to be less suitable for trembling vibrations of this kind. And even if the moving force is large enough, we search in vain for a volume of sound that corresponds to the moving force, unless we have an instrument with the proper capacity. The observations that Mersenne has made in book 2, proposition 39, have been taken from sounds so great that they cannot be the subjects of musical consideration. Therefore we do not think that they are going to be of any use for us here. It seems as if this calculation should take place only with the greatest difficulty, if, as this great music theorist claims, someone wants to establish the sound of some given string as the measure for the remaining strings, since he must find out, in an examination that is as precise as possible, not only the thickness and length of the other ones, but also the solidity of the material, in what way the proportioned force and several other factors relate to the given string. For the musician this knowledge is surely sufficient on this matter, that he rightly knows, depending on the variety of the subject that is sung, when the strings should be struck more strongly or the voice strained, or when it should be played more calmly. This distinction the practitioners usually indicate with the words *forte* and *piano*, and with others of similar kind.

Thesis 6.

Moreover, we include all variety of sound as regards high and low under pitch, so that we safely establish that whatever consonance or dissonance that can be noticed in all music must be ascribed to it. But the slowness and frequency of the vibrations, which a sounding body and air bring about, are rightfully reckoned to be the only foundation of lowness and height in sound by the most diligent physico-musicians. The frequency of vibrations should here be understood not so much as the speed of the motion, although also this is absolutely necessary, as the frequency, with which the chord now moved touches the outermost parts of its spheroids. For if only the speed to traverse a space, which is between its two farthest borders, should produce

non posset chorda unum et eundem sonum per integram recursuum periodum reddere, siquidem quo propior fit quieti, hoc minores quoad spatia faciat vibrationes, quae tamen quoad temporis momenta omnes sunt aequales. Alias enim sonum acutiorem in fine quam in initio sui motus contra omnem experientiam daret. Quamobrem, si in plano hasce vibrationes fieri cogitarem, crebritatem illarum ex itu et reditu super lineam rectam optime cognoscere possemus. Quo enim citius chorda situm naturalem transit, eo acutiorem quoque sonum edere debet. Transit autem istum situm in singulis tam cursibus quam recursibus tempore omnino aequali. Ex quo manifestum est ut majorem vim ita et majora spatia ad primas et maximas vibrationes quam ultimas istas desiderari. Unde in hoc negotio crebritatem a celeritate diligenter distinguendum, illamque in omnibus unius ejusdemque soni vibrationibus semper esse aequalem, hanc vero in singulis minui statuendum esse constat. Jucunda sane haec est consideratio, ubi consonantias in compositionibus et cantibus quibuscunque nihil aliud esse invenimus quam convenientiam quandam vibrationum soni unius cum concussionibus alterius vel plurium in certo quodam vibrationum numero et temporis momentis. Quae quo fuerint crebriora, hoc simpliciorum quoque indicant consonantiam. Quam doctrinam accurate propositam, praeter Mersennum, *Disputatio de sono*, cujus superius fecimus mentionem, habet. Nobis prima tantum affectio soni, quam longitudinem diximus, heic loci expendenda venit.

Thesis VII.

Ea vero soni longitudo, quatenus Musicae considerationi est subjecta, ad certos quosdam terminos ita est restricta, ut si illos transeat, manifestissimas non possit non dare procellas. Scilicet quo sonus Musici nomen consequeretur, necessarium fuit ut ad certa temporis intervalla redigeretur, extra quae si vel tantillum vagetur, omnem suavitatem et gratiam merito perdit. Vix enim profunditatem soni recte aestimare, hoc est, concentum aliquem musicum deprehendere potes, si longitudinem seu justam temporis mensuram ab illo tollas, adeo ut, licet prioris illius affectionis accurata proportio ad quancunque cantilenam summe necessaria sit, ea tamen absente sola temporis ratio non exiguam sono jucunditatem conciliare valeat, id quod ex tympanis militaribus in sequentibus ibimus probatum. Quamobrem in primis Musicae rudimentis hanc sibi notitiam ita comparare debere futurum Musicum judicamus, ut non solum manu aut pede in justa intervalla sonos dividere sciat, sed absque signis ejusmodi externis spirituum quodam motu istas temporum portiones sentire possit. Hoc autem est, quod *Tactus Musici* nomine apud Musurgicos et Practicos venire solet, estque nihil aliud quam certa temporis

a variety of sound, a chord would not be able to render one and the same sound in a complete period of movements, since the closer it comes to rest, the smaller vibrations in space it admittedly produces, and these are nonetheless all equal as regards moments of time. For otherwise it would bring about a higher sound at the end than at the beginning of its motion, in conflict with all experience. For this reason, if we imagine that these vibrations come about on level ground, we would be able to find out their frequency very well from their movements forwards and backwards over a straight line. For the quicker a string passes its natural place, the higher sound it must also emit. It passes this place both in every motion forward and backward in a time that is quite equal. From this it is evident that just as is a greater force, so are also bigger spaces required for the first and greatest vibrations than for the last ones. Therefore it must obviously be stated that frequency should be carefully distinguished from speed in these matters, and that the former is always equal in all vibrations of one and the same sound, but that the latter diminishes in each and every vibration. Delightful indeed is this consideration, when we find that consonances in compositions and songs of all kinds are nothing other than a sort of concord of vibrations of one sound with the concussions of another or several others in a certain number of vibrations and moments of time. The more frequent these are, the simpler is also the consonance which they indicate. This theory is carefully presented, besides Mersenne, in the disputation on sound that we mentioned above. By us only the first property of sound, which we called duration, is to be investigated here.

Thesis 7.

But this duration of sound, as far as it is subjected to a musical consideration, is restricted to some certain limits to such a degree, that if it transgresses them, it cannot but produce very evident disturbances. In order for sound to acquire the name of music, it was of course necessary that it was brought into fixed intervals of time, and if it diffuses beyond them if only so little, it rightfully loses all sweetness and charm. For you can hardly assess the pitch of sound correctly, that is, discern any musical concord, if you remove duration or the proper measure of time from it. In consequence, although a precise proportion of the former property is highly necessary for any song whatsoever, when this is absent the principle of time alone is able to provide the sound with not a small delight. This we shall prove in the following with the aid of military drums. For this reason we think that the future musician in his first rudiments of music must obtain this knowledge to such a degree, that he knows not only how to divide the sounds into proper intervals with hands and feet, but that he is able to feel these portions of time without any outward signs of this kind, by a certain motion of the spirits. It is this that usually comes under the name of *tactus musicus* among music theorists and practitioners, and it is nothing other than a fixed measure of

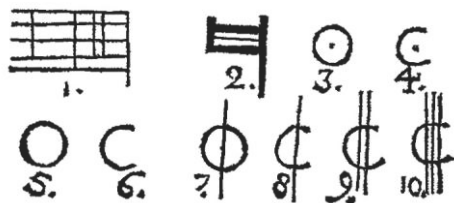
mensura circa sonum observata et manus depressione et elevatione plerumque notata. Ubi sciendum est modum illum, quem gentes variae varium heic adhibent, aliquam Tactui varietatem non inferre. Sive enim manum demittamus et elevemus, quemadmodum apud nos fieri solet, sive circulum aliorum populorum more formemus, sive quacumque collegium aliquod Musicum voluerit ratione hoc temporis spatium signemus, perinde omnino est, modo Tactus partes aequales a singulis collegis distincte percipiantur. Sed et sine aliquo signo externo manu aut pede facto interdum canitur a peritioribus, qui etiam aliorum canentium Battutas (sic enim ab Italis mutuo sumto vocabulo signum istud appellant) singulas solo auditu distinguere possunt. Immo eorum, qui saltant, multi Tactus rationem nesciunt, et tamen in Choreis et Tripudiis suis hanc temporis Mensuram tanquam intelligerent et quasi summo studio servant. Cujus rei causam Cartesius in *compendio Musico* hanc veram tradit, quod cantores et qui instrumentis ludunt in initio cujusque mensurae vocem naturaliter intendant, seu fortius instrumentum pulsando vehementiorem ac distinctiorem sonum emittant. Unde spiritus animales in singulis istis momentis fortius concutuntur, adeo ut saltantes ad certos quosdam, quibus adsueverant, corporis motus tum naturaliter a Musica impellantur. E quibus sequi dicit feras, si doceantur et adsuescant, ad numerum saltare posse, quia tantum naturali ad id impetu opus est. De quantitate hujus Battutae seu Mensurae nihil fere dicere habemus, quoniam ea pro varietate ingeniorum in diversis populis adeo varia deprehenditur, ut vix ei certum temporis momentum praescribere fas sit. In explicatione Manus Musicae Guidonianae, Mersennus, lib. 6: *Mensuram seu Tactum* vocat *spatium temporis, quo semel pulsatur arteria, vel potius secundum horae minutum labitur*. Quam mensuram an rite quis observare semper possit, heic nos non quaerimus, sed iis potius attendimus praeceptis, quae paulo inferius, nempe lib. 7 *de cantibus* ex Alberto Bannio, de iis, quae ad Musicam Flexanimam sunt necessaria, adducit, scilicet lentam admodum constituendam esse mensuram, et ad eam tarditatem productam, ut syllabae clare et distincte pronunciari ac sine confusione audiri queant. Et licet interdum velocior tactus designetur, in acceleratione tamen maximam cautelam adhibendam esse, ne verborum aut syllabarum justa pronuntiatio ullo modo impediatur. Ubi vero plura sunt instrumenta, et cantilena minutis constat notulis, singulas fere Battutas prioribus fieri velociores nimis frequenter observare licet, adeo ut qui instrumentis ludunt de celeritate Tactus quasi certare videantur, nihil tamen minus quam tale certamen cogitantes. Immo in iis, qui aestum illum sedare non didicerunt, etsi soli ludant, idem ut plurimum contingere solet.

time that is observed as regards sound, and is for the most part marked out by a lowering and raising of the hand. In this context one must know that the different methods that different people employ here do not bring about any variety in the *tactus*. For it is all the same whether we lower and raise the hand, in the way that it is usually done among us, or if we fashion a circle, following the custom of other people, or if we indicate this space of time with whatever method that some *collegium musicum* has preferred, provided that the equivalent parts of the *tactus* are clearly perceived by each and every colleague. But more skillful people sometimes also sing without any outward sign made by hand or foot, and they can even distinguish each and every *battuta* (for so they call this sign with a designation borrowed from the Italians) of the other singers only from hearing. Yes many of those who dance do not know the principle of *tactus*, and still they observe this measure of time in their different dances as if they understood it and seemingly with great eagerness. Descartes in his *Compendium musicum* relates that the true cause of this circumstance is this, that singers and those who play instruments by nature strain their voices at the beginning of every measure, or emit a stronger and more distinct sound by playing the instrument more strongly. Thereby the living spirits are shaken more strongly in each and every one of those moments, so that the dancing people are then naturally urged on by the music into some certain motions of the body, which they have become used to. He says that it follows from this that wild animals can dance rhythmically, if they are taught and get used to it, since only a natural instinct is needed for it. We have almost nothing at all to say about the quantity of this *battuta* or measure, since this is understood to be so varying, depending on the variety of dispositions in different peoples, that it would hardly be correct to prescribe a fixed moment of time to it. In the explanation of the Guidonian musical hand Mersenne says in book 6: ‘measure or *tactus*’ he calls ‘the space of time, during which the artery beats once, or rather a second passes by’. Here we do not investigate whether anyone would always be able to observe this measure correctly, but we rather pay attention to those precepts, which he adduces somewhat later, namely in book 7 ‘On songs’ from Joan Albert Ban, on what is necessary for music that affects the soul, namely that a very slow measure must be established, and to this a drawn-out slowness, so that the syllables can be clearly and distinctly pronounced and heard without confusion. And although a faster *tactus* is sometimes marked out, the greatest caution should be employed in the acceleration, lest the correct pronunciation of words or syllables is impeded in any way. But where there are several instruments, and where the song consists of notes of short duration, it is too often possible to notice that almost every *battuta* becomes swifter than the previous ones, so that those who play the instruments almost seem to contend the speed of the *tactus*, and still they do not think about anything less than such a contention. Yes in those who have not learnt to restrain this ardour, even if they play alone, the

Sed hoc etiam commotioni spirituum esttribuendum, qui semel excitati, quo saepius concutiuntur, hoc majorem motus vim in membris exercent. Quin et in una eademque cantilena – non dicamus cum venia, sed jussu Musicorum – nunc velocius, mox iterum languidius Tactum incedere animadvertimus, adeo ut saepe omnia instrumenta jam quietura videantur, cum redintegrato quasi certamine novis viribus personare incipiunt. Immo in voce ipsa pro rei gravitate aut alacritate interdum tardioribus et rursus celerioribus Battutis uti perquam decorum est. Ea vero mutatio in Symphoniis et Sonatis frequentissima occurrit, et signis *Adagio* atque *Allegro* aliisque apud alios notatur.

Thesis VIII.

Sed antequam longius in hunc campum progrediamur, veterum Sonos Musicos mensurandi rationem paucis indicare juvabit, ut quantum ab operosis istis prolationum signis, quae magno numero olim adhibebantur, hodierna Musica recesserit, oculis subiiciatur. Certe insignis illa apud antiquos Musicos difficultas notatur, qua, cum cantilenas suas minutas reddere vellent, notulis istis minimis, utilissimo illo recentiorum invento, fere destituebantur. Unde factum est, ut varia signa sint inventa, quorum decem Kircherus, lib. 10, *de Tempore Musico*, pag. 676, hujusmodi figuris et ordine proponit:

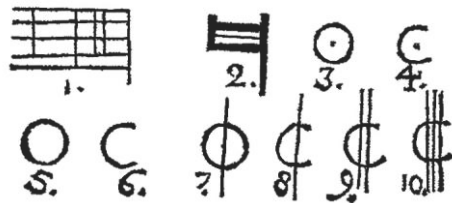


Horum officium erat, quanta in notis proferendis celeritate cantores uti deberent, monere, ita quidem ut quod primo loco conspicitur tardissimum, secundum vero multo celeriores cantum, et sic porro reliqua poscerent, adeo ut singula quae sequuntur duplo, quam quae praecedunt, velociorem prononciationem notarum requirerent. Ideo vero certis proportionibus haec signa alligata erant, ut cuivis primo intuitu constaret unam notam ad alteram nunc duplam, nunc quadruplam, nunc denique octuplam esse, pro ratione signorum, quae cantilenis diversis diversa praefigebantur. Scilicet quando signum contra signum, ut illi ajebant, cantabatur, licet duae voces similibus uterentur notis, tamen quae brevius habebat signum, ita suarum valorem notarum minuere tenebatur, ut contra unam alterius, duas, tres, quatuor, octo, etc., suas recitare posset.

same usually happens very often. But also this should be attributed to the agitation of the spirits, which when they have been excited once, employ a greater power of motion in the limbs the more often they are agitated. Yes even in one and the same song we notice that the *tactus* advances – we should not say with the permission, but on the command of the musicians – now more quickly, soon again more slowly, so that all instruments are often seemingly going to rest, when the contention is restored, so to speak, and they begin to resound with new power. Yes in the voice itself it is very suitable sometimes to use slower and again swifter *battute*, depending on the solemnity or liveliness of the subject. However, this alternation occurs very often in symphonies and sonatas, and it is marked out with the signs *adagio* and *allegro*, and with other by other people.

Thesis 8.

But before we continue further into this field, it shall be useful to point out in a few words the method of measuring musical sounds of the ancients, so that it is exposed to our eyes how much the music of today has departed from those troublesome signs of prolation, which were once employed in great number. Certainly this considerable difficulty is noticed among the ancient musicians, that they were almost destitute of the very small notes, this most useful invention of our times, when they wanted their songs to be figurate. That is why various signs were invented, ten of which Kircher presents in book 10, ‘On Musical Time’, page 676, with figures and in an order of this kind:



Their function was to instruct the singers on how great a speed they should employ in pronouncing the notes, namely in such a way that what is seen in the first place called for a very slow singing, but the second a much quicker, and the others like that onwards, so that every one that follows required a twice as swift pronounciation of the notes than the ones that precede them. These signs were bound to certain proportions in such a way, that it was obvious to anyone at first sight that one note was now duple in relation to the other, now quadruple, now finally octuple, depending on the different signs that were attached at the beginning of the different songs. For when they sang *signum contra signum*, as they called it, although two parts used similar notes, the part that had a shorter sign had to diminish the value of its notes in such a way, that it could recite two, three, four, eight, etc., of its own against

Quemadmodum id Kircherus loco, quem diximus, exemplis demonstrat. Quae si huc transferre animus esset, operae pretium non futurum existimamus, siquidem nostro hoc tempore nemo sit, qui istis difficultatibus involvi se patiatur, ut unas easdemque notas tam diversis prolationibus enunciet, praesertim cum minimas jam notas et semiminimas, fusas ac semifusas habeat veteribus, teste Kircheri, pag. 683, ignotas, quibus multo, quam signis istis, commodius voces brevissimas breviores reddere possit. In proportionis triplae designatione quid desideratum sit, hisce Kircheri verbis *Artis Magnae*, p. 683, docemur: *In temporis vero perfecti sive ternarii, aut sesquialtera, prolatione non minor confusio spectatur. Nam omnibus memoratis signis proponendo numerum ternarium aut ternarium cum binario, pulchre quidem distinguebant prolationem unam ab altera, at in temporis duratione nullam assignant differentiam.* Quae plura de signorum istorum ratione dici possent, cum recentiori Musicae nullum praestent usum, consulto omittimus, ut ad ea, unde digressi sumus, citius revertamur.

Thesis IX.

Communem autem illam Musicorum Mensuram seu Tactum tam apud eos, qui naturae Musicae contemplationi sunt dediti, quam qui in componendis cantilenis sunt occupati, in duplici differentia esse invenimus, et a Pedibus Poeseos, inter quam et Musicam satis propinqua cognatio deprehenditur, ductis appellationibus vel *Spondaicum* vel *Trochaicum*, seu *Triplam* nuncupari. Quae voces ipsae utriusque generis partes et proportionales ostendere nobis possent, adeoque supervacaneum forte videretur rei per se clarae aliquam lucem foenerari velle. Verumtamen cum a proposito nostro haec expositio non sit aliena, paucis eam, prout ab optimis Musurgicis traditam invenimus, dare juvabit. Quidquid usquam est objecti jucundi, id quo clarius et distinctius percipitur, hoc majorem sensui parit delectationem. De incognitis enim et obscuris nullum aut erroneum fieri iudicium solet. Ut vero distinctum quid sensibus nostris exhibeatur, partes illud habeat minus inter se differentes necesse est, siquidem differentia nimia confusionem in perceptione generet, nec qua decet accuratione rem considerare permittat. Partes enim singulae singularem requirunt attentionem, ut totius natura recte intelligatur. Jam omnes partes hoc propius inter se convenire, quo major inter illas proportio reperitur, nemo sane negabit. Experiatur id, cui volupe est, in numeris 2 et 3. Certe prae ceteris omnibus, quales sunt 5, 7, 9, 10, 11, etc., illos cum unitate convenire deprehendet. Unde proportionem duplam et triplam perceptioni facillimam omnium esse manifestum evadit. Quam enim difficilis

one of another voice. This is how Kircher explains it with examples in the place that we mentioned. If our intention would be to make use of this here, we think that it would not be worth the effort, since there is nobody in our time, who allows himself to be wrapped up in such difficulties, that he specifies the one and the same notes for such diverse prolations, especially since he already has the minim notes, the crotchets, quavers and semiquavers that were unknown to the ancients, which Kircher attests in page 683. With these he can render the shortest voices as shorter in a much more convenient way than with the former signs. What is needed in the designation of the triple proportion, we are taught by these words from Kircher's *Ars magna*, page 683: 'A no smaller confusion can be noticed in the prolation of the perfect or ternary time, or in the sesquialter prolation. For when all signs had been memorized they admittedly distinguished one prolation from another very well by setting out a ternary number, or a ternary with a binary, but they do not mark out any difference in the duration of time'. We deliberately omit to mention more things that could be said on the principles of these signs, since they are of no use to contemporary music, so that we more quickly return to those things, from which we have digressed.

Thesis 9.

We find that this common measure or *tactus* of the musicians is of two different kinds both among those who are devoted to surveying the nature of music, and those who are engaged in composing songs, and that it is called either *spondaic* or *trochaic*, or *triple*, with designations taken from the poetical feet, between which and music a very close kindred can be found. These words would by themselves be able to reveal the parts and proportions of both kinds to us, and it would perhaps also seem superfluous to want to lend some light to a subject that is so evident in itself. But since this description is not irrelevant to our plan, it shall be useful to expound it in a few words, according to how we find it related by the foremost music theorists. Whatever delightful object there is, this produces the greater pleasure to the senses, the more clearly and distinctly it is perceived. For usually, on unknown and obscure things no judgment is made, or if one is it is in error. But in order for something to be displayed to our senses as distinct, it is necessary that it has parts that differ less in relation to each other, since too much difference generates confusion in the perception, and does not allow us to examine the thing with suitable precision. For each and every part requires special attention, in order for the nature of the entirety to be properly understood. Nobody at all denies that the more closely all parts concord with each other, the greater proportion is found between them. For the one who wishes to, this can be proved in the numbers 2 and 3. He shall certainly find that these go better together with a unity than all others, such as 5, 7, 9, 10, 11, etc. Thereby it becomes evident that the duple and triple proportions are the most easy of all for the perception. For how difficult

foret cantus, si uni notulae 5 aut 7 aequales opponeremus? Et quis quaesumus harum distinctionem accuratam auditu percipere posset? Ut jam de progressionibus ulterioribus nihil dicamus. Manet itaque proportio dupla et tripla ut simplicissima, ita quoque Musicis sufficientissima. Ubi vero singuli tactus interdum 4, 6, 8, 12, 16 et 32 partes aequales complectuntur, non cogitandum est aliam ibi proportionem, sed tantum numerorum simplicium quandam multiplicationem factam esse. Idque inde facile constat, quod ejusmodi numeri non inter se primi, sed compositi, intelligantur.

Thesis X.

Proportio itaque dupla, seu Tactus Spondaicus, tardo gressu et magnifico incedit, et in rebus gravibus, maxime vero sacris, usurpatur. Cujus notulae, quotquot omnino dari possunt, ad duas partes aequales reducuntur. Quae partes simplici positione et elevatione manus tempore prorsus aequali designantur. Quoniam vero rarius ejusmodi notae habentur, quarum duae integrum tactum absolvunt, et ut singulae partes in Musica diminuta clarius percipiantur, imprimis ab iis, qui collegiis Musicis nuper sunt adsciti, qui alias minutissimis istis notulis justo diutius inhaerere facile possent, ideo in quatuor partes aequales hunc tactum distinguere illi solent, qui ceteris Battutas seu Plausus praeceunt. Quae sane ratio hoc nomine multum praestare videtur, quod *semifusae* istae, quarum 16 unum conficiunt Tactum, ut plurimum quatuor in singulis classibus duplici linea transversim ducta combinentur, atque sic unaquaeque ejusmodi classis cuique quartae Tactus parti exacte respondeat. Id quod junioribus, immo et illis, qui non exiguam, eamque nec inutilem huic negotio operam impendisse sibi videntur, perquam proficuum animadvertitur. Alias hic Tactus species diversas nescit, sed semper modo prorsus simili incedit, nisi quod nunc segniorem, nunc alacriorem ipsa Cantus materia, ut superius est ostensum, interdum poscere soleat. Spondaicum autem hunc Tactum a pede isto Poetico notissimo nominari paragrapho praecedente diximus, at Vossius in laudatissimo opere *de Viribus Rythmi*, p. 86 et 130, illum (Mensuram quadratam appellat) tam hoc spondeo, quam ceteris omnibus, si Dispondeum exceperis, pedibus metricis destitui affirmat, et hoc nomine indignam mensuram musicae appellatione judicat. Ut est ille totus in eo occupatus, ut antiquae Musicae praestantiam prae hodierna extollat. Cui licet, nemo negare ausit nostri temporis Musicam a veterum ista longe diversissimam esse, vix tamen quisquam Musicorum sic assentiri velit, ut nullam omnino hodiernae Musicae laudem relinquat.

would not singing be, if we opposed 5 or 7 notes as equivalent to only one? And who, we ask, would be able to perceive the precise distinction between them with his hearing? And this is to say nothing about further advancements. Therefore, just as the duple and triple proportions continue to be the simplest, they are also the most adequate for musicians. But when each and every *tactus* sometimes comprises 4, 6, 8, 12, 16 and 32 equal parts, one should not think that there is another proportion there, but only that there has been some multiplication of the simple numbers. And thereby it is easily settled, that numbers of this kind are not understood to be primes in relation to each other, but composite.

Thesis 10.

Accordingly the duple proportion, or the *tactus* spondaicus, advances in a slow and eminent course, and it is used for solemn subjects, but especially for sacred ones. Its notes, no matter how many they can be altogether, are reduced into two equivalent parts. These parts are marked out with a simple lowering and raising of the hand in a time that is completely equal. But since notes of this kind can be found more rarely, two of which complete a whole *tactus*, and for the single parts to be more clearly perceived in figurate music, especially by those, who have recently been admitted among musical colleagues, who could otherwise easily hold the notes of very short value longer than is correct, therefore these usually divide this *tactus* into four equivalent parts, who lead the others with *battute* or handclaps. This method really seems to be the best by far for this reason, that the semiquavers, sixteen of which make up one *tactus*, are for the most part combined four and four into every single group, with a double line drawn straight through it, and thus each and every group of this kind corresponds exactly to every quarter of the *tactus*. This is noticed to be extremely useful for younger people, yes even for those who seem to have devoted not a small labour, nor a useless one, on this matter. Otherwise this *tactus* does not know of different species, but always advances in a quite similar way, unless the very subject of the song, as was demonstrated above, usually sometimes demands that it is now slower now quicker. We said in the preceding paragraph that this spondaic *tactus* has its name from the very well-known poetical foot, but Vossius in his most praiseworthy work ‘On the powers of rhythm’, pages 86 and 130, declares that it (he calls it square measure) is destitute both of this spondee, and of all other metrical feet, if you make an exception for the double spondee, and for this reason he considers the musical measure to be unworthy of the designation. He is so entirely engaged in this matter, that he exalts the superiority of ancient music to that of this day. Nobody, who is able to, has dared to deny that the music of our time is very different from that of the ancients, but hardly any of the musicians want to admit it to such a degree, that he leaves no praise at all for the music of our time.

Quorum enim ratio diversa esse deprehenditur. Ea quo minus in suo genere simul excellant, non videmus quid prohibere possit.

Thesis XI.

At Tactus Trochaici alia proportio est, aliaque Battutarum designatio. Nempe proportionem tripla ille semper delectat, et positionem ac elevationem manus sua natura inaequalem adhibet. Nam tantum per multiplicationem numerorum oriuntur interdum species diversae, elationem manus demissioni aequalem habentes. In hac autem mensura sic quidem Battutas designare nostris usu receptum est, ut dum duas priores Tactus partes recitant, manum demittant, tertiam vero pronunciantes illam elevent tempore admodum brevi, nempe duplo, quam in positione erat, celeriori. Quam rationem etiam antiquis familiarem fuisse Mersennus, lib. 7, *de cantibus*, pag. 153, docere potest, adeo ut hoc solum nomine commendari debere videatur. Verum enimvero, si ita hunc ordinem invertere quis vellet, ut pronuntiatione primae Tactus partis manum debita celeritate poneret, et in duabus reliquis recitandis tempore duplo longiore eam elevaret, haud sane rationibus destitueretur. Etenim prior iste modus in medio descendendi cursu manus motum non exigua cum violentia sistit, cum tamen in ascendendo seu elevatione, ubi major sentitur difficultas, aliqualis ejusmodi quies – ut distinctionem illam partium manu significatam sic appellemus – magis necessaria habeatur. Deinde, ut superius monstratum est, singuli Tactus, imprimis Trochaici, majori cum vehementia naturaliter incipiunt, adeo ut sine plausibus initia Tactu hinc sentiri possint. Id vero ut a singulis Musicis rite observetur, posteriori modo multo quam priori efficacius obtineri potest. Et praeterea quando proportionem duplam ad Triplam redigimus, non more vulgi, de quo mox, posteriores Tactus partes, sed vero priores duas in unam contrahimus. Unde etiam in designatione Tactus manu facta, in initio et non fine cujusque mensurae tempus duarum partium in momentum unius esse mutandum manifestum evadit. Sed et inter veteres ac recentiores Musicos non exigua circa hanc proportionem notatur differentia. Illi enim vix ultra tres, quod nos sciamus, Tactus Trochaici species adhibere soliti sunt. Quemadmodum ex Mersenno clarissimi Joannis Alberti Bannii sententiam lib. 7 explicante discere licet, qui praeter *Triplam*, *Sesquialteram* et *Hemiolam* proportionem nullam aliam mensuram adducit. Quem tamen, si quid hujusmodi in veteribus invenisset, id sive studio, quo in ceteris notatur candore, sive oscitantia, quae alias ejus diligentia est, praeterisse non sustinemus judicare. Recentioribus vero tanquam peritioribus Practicis non sufficere visae sunt tres illae veterum

For their basic principles are found to be diverse. We do not see what could prevent that they are both very fine at the same time in their own way.

Thesis 11.

But the proportion of the trochaic *tactus* is different, as is the demarcation of its *battute*. Certainly it always delights in a triple proportion, and employs a lowering and elevation of the hand that is unequal by nature. For only by a multiplication of the numbers different species sometimes come about, in which the elevation of the hand is equivalent to the lowering. But in this measure it is in fact customary by usage for our people to mark out the *battute* in this way, that while they recite the two first parts of the *tactus* they lower the hand, but while pronouncing the third they raise it in a very short time, namely twice as fast as in the lowering. Mersenne, in book 7, ‘on singing’, page 153, can inform us that this method had also been well known for the ancients, and therefore it must seemingly be commended only for this reason. But to be sure, if anyone would like to invert this order in such a way, that he lowered his hand with due speed in the pronunciation of the first part of the *tactus*, and raised it in a twice as long time while reciting the two remaining ones, he would certainly not be lacking reasons. For this first way checks the motion of the hand with not a small ferocity in the middle of the course downwards, while in the ascending or raising, where a greater difficulty can be noticed, some rest of this kind – let us call the separation of the parts that is indicated with the hand thus – is considered to be more necessary. Thereafter, as was demonstrated above, each and every *tactus*, above all the trochaic ones, naturally starts out with greater force, so that the beginnings of the *tactus* can be felt thereby without beats. But in order for this to be duly noticed by each and every musician, this can be achieved much more effectively in the later way than in the former. And in addition to that, when we restore the duple proportion to a triple, we contract, not in the manner of the common people, about which we shall soon speak, the later parts of the *tactus*, but the first two parts into one. Thereby it becomes evident also in the demarcation of the *tactus* made with the hand, that the time of the two parts should be changed into the moment of one at the beginning and not at the end of each measure. But not a small difference as regards this proportion can also be noticed between ancient and contemporary musicians. For the former usually, as far as we know, hardly employed more than three species of the trochaic *tactus*. Thus we can learn from Mersenne, who in book seven explains the view of the most illustrious Joan Albert Ban, who adduces no other measures besides the triple, the sesquialter and the hemiola proportions. But we do not venture to judge that he, if he had found anything of this kind among the ancients, had passed this by either by intention, in which he is in other circumstances known for sincerity, or out of unconcernedness, which is otherwise his diligence. But to the contemporaries, being more skilful

species, quarum una tres integros tactus spondaicos, secunda sesquialterum, et tertia tres quartas unius integri partes continent. Sed hisce plures addere placuit, Musicam magis diminutam reddentes, quibus tamen, si eam speciem, quae sex quartarum est, excipias, instrumenta saepius quam voces adhiberi solent. Sed hasce, quotquot omnino sint aut esse possint, nihil aliud esse quam multiplicatos Triplae proportionis terminos, pro lubitu a Musicis peritis adornatos, cuiusvis inspicienti obscurum esse nequit. Quanquam vero non sit in hujuscemodi speciebus diversis diversa, sed prorsus eadem proportio, tamen non raro ex iis diversimode nos permoveri necessum est fateamur. At illa vis et potestas non est specierum, sed pedum diversorum, seu diminutionis illius, quam singulae notae subire coguntur.

Thesis XII.

Porro a peritioribus Musicis in hoc Tactu adhibendo plebeios plurimum recedere animadvertimus, ita quidem, ut his cum illis non aliter ac duobus saltantibus, quorum unus sursum fertur alterius corpore deorsum vergente, in hac re conveniat. Unde etiam est quod, qui artem saltandi ad pulsum instrumentorum a peritis factum doctus est, vix ac ne vix quidem plebeiorum tripudiis interesse queat. Certe, quoniam singulae Tactus partes singulos corporis motus requirunt, adeo ut si quis contra faciat naturali isto impulsu neglecto, non exiguum spectatoribus molestiam creare deprehendatur, ideo, inquam, flexiones corporis prorsus contrarias recipere ille tenetur, qui priori modo adsuetus. Ad inversam illam plebis consuetudinem se demittere cogitur. Rationem vero, qua Tactum Spondaicum ad Trochaicum redigere Musici solent, quamvis notioem quam ut heic inculcari debeat, esse non negemus. Haud tamen abs re futurum arbitramur unicum tantum ejus rei exemplum adducere, differentiam plebeios inter et peritiores practicos monstraturum. Notum, inquam, est, hos mensuram illam duplam in Triplam sic mutare, ut priora duo cujusque Spondaici Tactus tempora in unum colligant, posterioribus integris relictis, id quod ex choreis, quas *Poloness* et *Proportion* nominant, manifestum evadit. Ibi enim in secundo saltu seu *Proportione* cantilena, quae prius adhibebatur, eadem qua notulas repetitur, sed qua mensuram Tactus perquam diversa, quod vel ex effectibus, scilicet Tripudiis, ad quae saltantes necessario compelluntur, cognosci potest. At plebeiis heic familiare admodum est modo contrario suas Triplas instituere, ita ut prioribus Tactus Spondaici partibus intactis manentibus, posteriores corripiant et ad tertium Triplae momentum contrahant.

practicians, these three species of the ancients have seemed not to suffice, one of which contains three complete spondaic *tactus*, the second a sesquialter, and the third three quarters of one complete *tactus*. But it has been decided to add more to these, which render the music more figurate, but these, if you except the species that consists of six quarters, are usually employed more often by instruments than by voices. But it cannot be obscure to anyone that perceives them that these, however many they are or can be in the whole, are nothing other than multiplied terms of the triple proportion, which are embellished by the most skilful musicians as they wish. But although the proportion is not different in different species of this kind, but quite the same, it is necessary that we acknowledge that we are not rarely moved by them in different ways. However, this force and power does not belong to the species, but to the different feet, or to the diminution, to which each and every note is forced to submit.

Thesis 12.

Furthermore we notice that simple musicians diverge a great deal from the more skilful in the practice of this *tactus*, namely in such a way, that the latter in this matter agree with the former in no different way than two persons dancing, one of whom is carried upwards while the other one's body moves downwards. This is also why he, who has learnt the art of dancing to the beat of instruments made by skilled people, can hardly, and not even hardly, take part in the dances of simple people. Assuredly, since all single parts of the *tactus* require specific motions of the body, so that if anyone neglects this natural impulse and acts differently, he is found to create a no small disgust in the audience, therefore, I say, he who is accustomed to the former way must accept turns of the body that are quite contrary. He is forced to lower himself to the inverted custom of simple people. But we should not deny that there is a method, according to which musicians usually convert a spondaic *tactus* into a trochaic, although it is so well-known that it does not have to be inserted here. We nevertheless think that it will not be out of place to adduce only one example of this matter, which will demonstrate the difference between simple and more skilled practicians. As I said, it is well known that the latter change the duple measure into a triple in such a way, that they assemble the first two times of every spondaic *tactus* into one, and leave the later ones untouched. This becomes evident from the dances, which they call *poloness* and *proportion*. For there in the second leap or *proportion* the song that was previously employed is repeated in the same fashion as regards the notes, but completely different as regards the measure of the *tactus*. This can even be seen from the effects, namely the dances, to which the dancing people are necessarily summoned. But for simple people it is here very customary to arrange their triples in an opposite way, so that while the first parts of the spondaic *tactus* remain untouched, they abridge the later ones and contract them to the third moment of the

Sed ut id planius fiat, exemplo, quod promittebamus, adducto obtinere nos posse confidimus, ex quo quam utrique viam in hoc negotio sequantur, quivis intelligere potest.

Numerus enim I. ipsam *Polonessam*: II. vero *Proportionem peritiorum*: et III. *Proportionem plebejorum* indicat.



Frustra omnino essemus, si, quam quivis facile videt, insignem inter utrosque differentiam pluribus ostendere vellemus. Id tantum monemus, nos quam potuimus simplicissimis notulis hoc exemplum proposuisse, eam potissimum ob causam, quod in ipsa praxi multae notae et puncta cum suis elegantissimis pro cuiusque industria a variis varie addantur, quae omnia ut unico exemplo illustrentur a nobis fieri nequit. Utut autem minutas notulas adhibere quis possit, certum manet, quam nos heic exhibuimus, partium proportionem ab omnibus observari.

triple. But we are sure that we can further evidence this, when the example that we have promised has been adduced. From this anyone can understand what course both follow in this matter.

For number I indicates the 'polonaise', but II the '*Proportz* of more skilful musicians', and III the '*Proportz* of simple people'.



We would accomplish nothing at all, if we would like to demonstrate the considerable difference between these with more examples, which anyone easily sees. We only emphasize this, that we have presented this example with as simple notes as possible, above all for this reason, that in practice itself many notes and dots with their graces are differently added by different people, depending on the design of each. We cannot illustrate all of this with only one example. But regardless of how anyone would be able to employ notes of short value, it remains certain that the proportion of the parts, which we have displayed here, is observed by everyone.

Thesis XIII.

Sed et utrique, tam duplae quam Triplae proportioni, temporis varietatem communem esse constat, ita tamen, ut posterior haec multo quam prior illa saepius istiusmodi vicissitudinibus obnoxia deprehendatur. Quanquam enim, ut antea dictum est, Spondaicus Tactus diversarum specierum capax esse nequeat, non exiguum tamen mensurae celeritatem res laetae atque jucundae ei addere solent, adeo ut si ad tarditatem illam incessus, quam res graves et tristes merito requirunt, respicias, insignem varietatem, adeoque duplicem velocitatem heic deprehendere possis. Ex variis saltationum generibus hodie usitatis id optime cognoscitur, circa quae haud minor Tactus quam melodiae rationem habere Musicum decet. Immo illius observatio adeo ibi necessaria est, ut cum circa acutum et grave impune peccare non raro liceat, injusta tactus mensura soloecismos admittere nunquam non sit reprehensione dignum. Hanc autem temporis varietatem indicaturi Musici, abrogatis ceteris signis, quae paragrapho 8 vidimus, **C** aut **♠** initio cujusque cantilenae diu praefixerunt, illo lentam mensuram adhibendam esse monentes, hoc vero cum linea transversim ducta duplo velociorem requirentes. Quemadmodum hanc rem Bannius, qui cetera hujuscemodi signa et characteres veterum prorsus reiicit, apud Mersennum, pag. 153, nobis explicat. Solent etiam recentiores istis signis in scriptis suis uti, sed quod hanc temporis diversitatem sic denotatam velint affirmare non possumus, quandoquidem hujus rei causa singulis fere cantilenarum membris sua *Grave*, *Largo Adagio*, *Allegro* et similia adiicere ament. Quid? quod non paucas hodie cantilenas videamus utroque hoc caractere destitutas, aut si habeant tantum ornamenti loco illud monstrantes. At de Tactu Throchaico res est manifesta. Ille enim in singulis fere Triplae speciebus non solum temporis mensuram, sed ipsam mensurandi rationem variat. Prius illud recentiori Musicae atque Antiquae commune est. Triplam enim majorem Sesquialtera, et hanc iterum Hemiola celeritate superat. Loquimur autem de celeritate Tactus in elevatione et depressione. Nam si Triplae istius majoris aut Sesquialterae notas singulas in suas partes minores redigere velimus, id quod interdum fieri solet, summam quidem digitorum velocitatem instrumenta requirent. Tactus tamen mensura eadem manebit. Antiqui autem Musici ut plures hisce jam nominatis Triplae species nesciverunt, ita nec de variis istis mensurandi modis, quos una cum multiplici ista Triplarum forma recentiores introduxerunt, usque adeo solliciti fuisse creduntur. Illas scilicet Triplas intelligimus, quae $\frac{6}{4}$, $\frac{3}{8}$, $\frac{6}{8}$, $\frac{12}{8}$ et plures singulis Tactibus comprehendunt. Quarum primam illam sex quartarum speciem non aliud quam duplicatam Hemiolam esse quis non videt? Aut ei prorsus similem alteram illam sex octavas complexam non aestimat?

Thesis 13.

But it is also evident that the variety of time is common to both, both the duple and the triple proportions, in such a way, however, that the latter is much more often than the former found to be subject of alternations of this kind. For although, as was mentioned earlier, the spondaic *tactus* cannot contain different species, cheerful and merry subjects usually add no small speed of the measure to it, so that if you consider the slowness of pace, for which weighty and sad subjects rightfully call, you can notice a considerable variety, and even a twofold speed here. From the different kinds of dances that are practiced nowadays this can be seen best of all. Concerning these the musician must take regard not less of the *tactus* than of the melody. Yes his attention is so necessary there, that it is always worthy of blame to allow solecisms because of an improper measure of the *tactus*, although it is not seldom possible to commit errors safely as regards high and low pitch. In order to indicate this variety of time the musicians, when the other signs that we saw in paragraph 8 had become obsolete, for a long time set out a **C** or **♢** at the beginning of every song, telling with the former that a slow measure should be applied, but with the latter, with a line drawn straight through it, demanding a twice as swift measure. In this way Ban, who completely rejects the other signs of this kind and the marks of the ancients, explains this circumstance to us in Mersenne, page 153. Also the contemporaries usually use these signs in their writings, but we cannot confirm that they want this diversity of time to be denoted thereby, since they love to attach their *grave*, *largo*, *adagio*, *allegro* and similar to almost every single section of the songs for this reason. Yes we even see not a few songs nowadays that are destitute of both these marks, or if they have it, they only show it as an ornament. But as regards the trochaic *tactus* the case is evident. For it changes not only the measure of time in almost every single species of the triple, but it changes the very method of measuring. The first of these is common to both contemporary and ancient music. For the major triple is exceeded in speed by the sesquialter, and the latter is so again by the hemiolia. We speak, however, about the speed of *tactus* in the raising and lowering. For if we would like to reduce all single notes of this major triple or sesquialter into their minor parts, which usually happens now and then, the instruments really require a very high speed of the fingers. But the measure of the *tactus* remains the same. The ancient musicians, however, just as they did not know of more species of the triple than the ones already mentioned, neither are they considered to have been very much concerned with those various ways of measuring, which contemporary authors have introduced together with the numerous kinds of triples. We namely understand these as triples, which comprise $\frac{6}{4}$, $\frac{3}{8}$, $\frac{6}{8}$, $\frac{1}{2}$ and more in every single *tactus*. Who does not see that their first species of six quarters is nothing but a doubled hemiolia? Or does not he think that the

Certe nisi mensurae aliquam celeritatem majorem posterior haec innueret, frustra eam esse non immerito judicare posses. Quamobrem etiam juniores Musicae studiosi magnam prioris istius speciei difficultatem evadere se posse credunt, si $\frac{6}{4}$ bifariam dividant, atque ex uno duos $\frac{3}{4}$ tactus conficiant. Quod ut heic, ita quoque si $\frac{6}{8}$ in $\frac{3}{8}$ eadem ratione mutent, satis commode procedere non quidem negamus, fieri tamen non debere. Inde judicare audemus, quod, ut antea ostendimus, initia singulorum Tactuum fortiori quodam spiritu ut plurimum fundantur. Unde ex hujusmodi divisione omnis illa gratia, et quod, nescio quid, a ceteris diversi his speciebus inest, nobis insciis eriperetur. Inter $\frac{3}{8}$ et $\frac{3}{4}$ species, si solam excipimus tactus velocitatem, nihil quicquam interesse intelligimus. At in illa, quae $\frac{3}{8}$ notatur, singulare quid reperitur, ita ut, si manus positionem et elationem respicias, si quoque in partes aequales singulos Tactus revera dividi consideres, Spondaicae an Trochaicae mensurae illam tribuas, jure dubitare queas. Verum enimvero in quatuor partes aequales divisibilem esse Tactui Spondaico non sufficit, sed ut illae etiam partes in minores quatuor aequales dividi possint, ad essentiam illius omnino requiritur. Quod cum de $\frac{3}{8}$ affirmare non liceat, Trochaico illum Tactui adscribi debere in confesso est.

Thesis XIV.

In his vero et similibus Triplarum speciebus numerus ille fractus, qui praepositur, ad integrum aliquod, quale est Tactus Spondaicus, respicere cuivis est manifestum. Ideoque etiam de natura Denominatoris est, ut is, quicumque demum, modo divisibilis sit, numero binario, minime vero ternario exacte dividi possit. Et hinc in omni ejusmodi fractione hujus officium est, quales tactus spondaici notae, breves scilicet an semibreves, minimae, semiminimae, an denique fusae cuique Triplarum speciei adhiberi debeant, ostendere, numeratoris vero, quot illarum singulis Tactibus constituendis sufficiant, indicare. Adeoque inferiorem numerum ad Tactum Spondaicum, superiorem vero ad Trochaicum respicere constat. Sed et quando ex una Tripla ad aliam transitus fit, non eos numeros fractos, quorum denominatorem solus binarius – quod ad Triplam omnino requiri jam modo fatebamur – sed quem etiam ternarius exacte partiri potest, Musici ponere solent. Patet illud ex speciebus $\frac{2}{3}$ et $\frac{1}{2}$, ubi ad tactum spondaicum, qui 6 aut 12 partes aequales formare nequit, hos denominatores referre non licet. Quapropter ad Trochaicum, qui proxime praecessit, omnino est respiciendum, ita quidem, ut cum sesquialtera,

other that comprises six eighths is quite similar to it? Surely, if the latter should not signify any greater speed of the measure, you could not unjustly consider it to exist in vain. For this reason even young music students believe that they can evade the great difficulty of that previous species, if they divide the $\frac{6}{4}$ into two parts, and create two $\frac{1}{4}$ *tactus* from one. Admittedly we do not deny that just as this proceeds suitably enough here, so it also does if $\frac{6}{8}$ changes into $\frac{3}{8}$ in the same way, but it must not happen nevertheless. Therefore we dare to conclude that, as we showed earlier, the beginnings of every single *tactus* are for the most part established with a kind of stronger breath. Thereby, from a division of this kind, all the charm and that, whatever it may be, which differs from the others in these species, would be snatched away from us without our knowledge. Between the $\frac{3}{8}$ and the $\frac{1}{4}$ species, if we make an exception only for the speed of the *tactus*, we understand that there is no difference at all. But in the one that is written as $\frac{1}{8}$ something unique can be found. So if you give regard to the lowering and raising of the hand, if you also consider that every single *tactus* is in fact divided into equal parts, you can rightly doubt whether you should attribute it to the spondaic or the trochaic measure. However, it is certainly not sufficient for the spondaic *tactus* to be divisible into four equal parts, but according to its nature it is completely necessary that also these parts can be divided into four smaller ones. Although it is not possible to confirm this as regards the $\frac{1}{8}$, it is obvious that it should be ascribed to the trochaic *tactus*.

Thesis 14.

In these and in similar species of triples it is evident to anyone that the fraction, which is located at the beginning, refers to something integral, such as the spondaic *tactus*. And therefore it is also part of the nature of the denominator, that it, of whatever kind it is, provided that it is divisible, can be exactly divided with a binary number, but by no means with a ternary. And therefore it is its function in every fraction of this kind to show which notes of the spondaic *tactus*, namely breves or semibreves, minims, crotchets, or finally quavers, should be applied to each species of the triples. But the function of the numerator is to indicate how many of them are sufficient for creating every single *tactus*. Likewise it is evident that the lower number refers to the spondaic *tactus*, but the upper to the trochaic. But also when there is a transition from one triple to another, musicians usually do not set out those fractions, the denominator of which only the binary – we recently said that this is needed in general for the triple – but which also the ternary can divide exactly. This is evident from the species $\frac{2}{3}$ and $\frac{1}{3}$, where it is not possible that the denominators refer to a spondaic *tactus*, which cannot create six or twelve equal parts. For this reason one must in general turn one's attention to the trochaic that preceded most closely, namely in such a way, that when the sesquialter, which is written with the

quae numero $\frac{3}{2}$ notatur, in speciem $\frac{2}{3}$ mutata occurrit, tunc tres illius partes in sex resolutas, et novem tales notulas huic ad singulos Tactus constituendum datas esse cogitemus. Pari quoque ratione e Sesquialtera ad Triplam $\frac{2}{1}$ migrare cantus solet. Sed an haec eadem species e $\frac{6}{4}$ aut $\frac{12}{8}$ educi queat, hinc dubitatio oritur, quod in hujusmodi conversionibus eandem mensurandi rationem, mutatis tantum notulis, a praestantissimis Musicis observatam videamus, ut in:



Alias etiam a tripla, exempli gratia $\frac{12}{8}$, ad Spondaicum absque interposito signo C satis frequenti redire possumus, nempe simplici permutatione Denominatoris et Numeratoris in $\frac{8}{12}$. Scilicet quoniam Tripla ista duodecim octavis Spondaici partibus, hoc est, *fusus*, ut vocant, constiterat, utique octo ejus partes Tactum nobis Spondaicum restituere manifestum evadit.

Thesis XV.

Ex hoc itaque fundamento errorem esse patet, si quis, ubicunque numeros notulis praefixos animadverterit, triplam simpliciter cogitet, adeoque hujus essentiam in numeris consistere sibi persuadeat. Nam, ut jam de exemplo a nobis adducto aliisque similibus nihil dicamus, opuscula Musica admodum egregia videmus aut signis C, Φ plane destituta, aut si interdum illa habent, non nudis, sed cum adjectis numeris insignita, quae sane meris Triplis referta judicare ignorantiae indicium esset. Quid enim frequentius quam in operibus, quae hodie prodeunt, Musicis Tactum Spondaicum numero binario significare? Certe quidem majorem illa nota, quam Characteres isti muti, rei cognitionem ostendit. Proinde non in solis numeris, sed in proportionem numerorum mensuram Musicam collocatam esse intelligimus, ita quidem ut, si unus tantum numerus fuerit positus, et is in duas solum partes aequales dividi possit, Tactus sit Spondaicus, si vero trifariam aequaliter partiri eum possimus, Tripla habeatur. Ubi autem numeri adhibiti fuerint fracti, tum de Numeratore idem prorsus judicium fieri debet.

number $\frac{3}{2}$, has changed and appears as the species $\frac{2}{3}$, then we think that its three parts have been resolved into six, and that nine notes of this kind are given to it in order to create every single *tactus*. For a similar reason the song usually changes from the sesquialter to the triple $\frac{2}{3}$. But the question arises hereby, if not this same species can be extracted from the $\frac{6}{4}$ or the $\frac{3}{8}$, since we see that in changes of this kind the same method of measuring, when only the notes have been altered, has been followed by the foremost of musicians, for example in:



Otherwise we can return also from a triple, for example the $\frac{3}{8}$, to the spondaic without the insertion of the very frequent sign C, namely by a simple alteration of the denominator and the numerator into $\frac{8}{12}$. Since this triple was namely made up by 12 eighth parts of the spondaic, that is, quavers, as they call them, it becomes evident that its eight parts restore the spondaic *tactus* to us.

Thesis 15.

It is thus evident from this foundation that it is a mistake, if anyone, as soon as he notices numbers attached before the notes, simply thinks of a triple, and also firmly believes that its essence consists in the numbers. For, just to say nothing about the example that was adduced by us and about other similar ones, we see very distinguished musical works that are either completely destitute of the signs C and Φ , or if they once in a while have them, they are marked out not with naked signs, but with numbers attached. It would really be an evidence of ignorance to consider them as full of pure triples. For what is more common than to express the spondaic *tactus* with a binary number in the musical works that appear nowadays? For the former mark certainly displays a greater knowledge of the matter than these mute signs. Accordingly we understand that the musical measure is located not in the numbers alone, but in the proportion of the numbers, namely in such a way, that if only one number is set out and this can be divided into only two equal parts, the *tactus* is spondaic, but if we can divide it equally into three parts, it is considered as a triple. However, where fractions are employed, then quite the same judgment should be made about the numerator.

Thesis XVI.

Haec pauca illa fuere, quae circa considerationem Tactus Musicam instituto nostro viribusque ingenii admodum exiguis sufficere visa sunt. Levia quidem illa, et rei dignitati, ingenue fatemur, neutiquam respondentia, pro quibus tamen summam scriptorum idem negotium, qua par esset, diligentia tractantium inopiam prensatum ire speramus. Equidem magna exstant et solidae eruditionis plena Musurgicorum opera, sed quae circa naturam soni consonantiarum et dissonantiarum atque similia tota occupantur, Tactum videlicet non nisi levi, quod ajunt, brachio tangentia. Quamobrem de veteribus hujus rei scriptoribus Kircherus, lib. 7, *de Musurgia Antiquo-Moderna*: *Tametsi, inquit, totum Musicae arcanum sub temporis exacta et varia prolatione consistat, fateor tamen nihil in tota Musica confusius, nihil imperfectius tractatum me reperisse. Integra opera de hisce a Franchino, Zarlino, Glareano, aliisque innumeris pene conscripta lego, adeo tamen indigesta et dissona, ut cum multum in iis legendis tempus impenderis, postquam ea absolveris, quid legeris vix dispicere possis. Sunt praeterea adeo in hoc negotio discrepantes musicorum opiniones, ut cui subscribas vix videas.* Quapropter si tenuitatem nostram ausam esse poenituerit, certe voluisse bene opportuno ipsi solatio erit. Sequitur jam ut vim et efficaciam, quam Tactus justa observatio in affectibus et animis hominum commovendis habet, ad rationem Physicam, si poterimus, paucis revocare adnitamur.

Thesis XVII.

De Musica veterum Pathetica, quantam illa habuerit vim et efficaciam, plurima in monumentis antiquis traduntur documenta, quorum non pauca admirari potius convenit, quam aptis demonstrationibus explicare velle. Unde nec raro viros eruditos videmus figmentis et fabulosis narrationibus hujuscemodi exempla annumerare, aliis tamen non tantum vera illa judicantibus, sed etiam secus sentientes, cum nimio sui seculi amore, tum rei non intellectae odio actos, praeter meritum artis nobilissimae, tam sinistra judicia tulisse statuentibus. Inter hos est Vossius, qui *de Poematum cantu et viribus Rythmi* tractatu singulari maximam veteris Musicae vim in accuratissima Rythmorum et pedum metricorum observatione constituisse perhibet, quique pag. 43 praeclarum veterum Musicorum in naturam syllabarum inquirendi studium hisce verbis commendat: *Quod si antiquos consulamus Musicos, quis non illos ad fastidium pene delicatos fuisse censeat, cum non contenti communi et recepta syllabarum divisione ad instruendam cantum brevibus breviores et longiores longis exigerent syllabas?*

Thesis 16.

These few things were the ones that seemed to be sufficient for our plan as regards the musical consideration of *tactus*, and for our very small intellectual abilities. We honestly confess that they were truly light and in no way corresponding to the greatness of the subject, but by these we nevertheless hope that we shall grasp the great scarcity of writers that treat the same matter with the diligence it deserves. There are indeed great works of music theorists that are full of real erudition, but these are entirely occupied with the nature of sound of consonances and dissonances and similar things, they namely touch upon *tactus* only superficially. For this reason Kircher in book seven 'on the ancient-modern *musurgia*' says about the ancient authors on the subject: 'Although the entire secret of music consists in an exact and varying prolation of time, I admit that I have found that nothing has been treated more confusedly in the whole of music, nothing more imperfectly. I read complete works on these matters written by Franchino, Zarlino, Glarean and almost uncountable others, but they are so badly arranged and confused, that, even if you invest much time in reading them, when you have finished them, you can hardly discern what you have read. In addition the opinions of musicians are so different on this matter, that you hardly see which one you should subscribe to'. If therefore it is dissatisfying that our poor work was ventured upon, the good intention shall surely be a suitable compensation to that. It now follows that we shall try to recall in a few words the power and efficacy, which a proper observation of *tactus* possesses in agitating the affects and minds of men, according to a physical principle, if we can.

Thesis 17.

On the *musica pathetica* of the ancients, how great a power and efficacy it had, several examples are related in the ancient works. It is rather appropriate to wonder at not a few of them, than to want to account for them with suitable explanations. Therefore we not rarely see that learned men count examples of this kind among fictitious and fabulous stories, while others still not only consider them to be true, but even state that those who think differently have passed such awkward judgments partly because of too great a love for their own time, partly driven by hatred, without regard to the merits of their most impressive knowledge, against a matter which they do not understand. Among them is Vossius, who in the splendid writing *On the singing of poems and the powers of rhythm* claims that the great power of ancient music consisted in a very precise observation of rhythms and metrical feet, and who on page 43 commends the excellent eagerness of the ancient musicians for inquiring into the nature of the syllables with these words: 'But if we consult the ancient musicians, who would not think that they were delicate almost to fastidiousness, when they, not being content with the common and customary division of the syllables, called for

Quippe cum tota Musica ab exacta temporum pendeat observatione, et quanto quaeque syllaba pluribus constet elementis, tanto plus temporis requirat, ut commode exprimatur, ne syllabarum quidem naturam negligendam esse credebant, veluti ad leniendum et asperandum cantum praecipue necessariam. In sequentibus e Dionysio Halicarnassensi voces ὁδός, ῥόδος, τρόπος, et στρόφος adducit, in quibus, licet breves dicantur priores quaelibet syllabae, satis tamen manifestum temporis discrimen in singulis proferendis requiri docet. Hanc, inquam, syllabarum habitam rationem totum Musicae patheticae negotium confecisse dicit, adeo ut hinc veteribus in proverbium cesserit sermo τὸ πᾶν παρὰ μουσικοῖς ὁ ρυθμὸς. Unde etiam ad quaestionem illam de enervi Musica hodierna ejusmodi responsionem educit, qua neglectum Rythmorum ceu verum insignis illius efficaciae expulsorem in recentioribus Musicis damnet. Sic autem pag. 59 loquitur: *Jam a mille et pluribus annis cessat inter Musicos magna illa ciendorum affectuum potentia, ex quo nempe desiit usus et scientia Rythmi, qui solus poterat praestare id, quod nullus hoc tempore possit praestare Musicus.* Multa sane in opere illo eruditissimo recentiores Musici habent, quibus artem suam non dicamus infra sortem veterum duci, nam id forte negare non audebunt, sed quae cum illa aliqua saltem ratione comparetur, indignam judicari intelligent. Quicquid autem sit, sua laude hodiernam Musicam frustrari non debere existimamus, licet eo, quo veterem illam fautores sui evehunt, eam ascendere non posse lubentes fateamur.

Thesis XVIII.

Quantum vero in animos hominum commovendos Musica recentiorum habeat potestatis tantum abest, ut nos heic sufficienter demonstrare cogitemus, ut potius vix ab ullo id rite determinari posse nobis persuadeamus. Quoniam non solum perfectum Musicum illud requirit, sed ingeniorum, quae singulis hominibus sunt, plenam notitiam studiorumque in uno et eodem homine diversis temporibus diversorum cognitionem, immo, quorum singulis momentis varia vis ac potestas est, affectuum perpetuam observationem postulat. Et licet haec omnia nota forent, aequae tamen ac in redigendis ad similitudinem omnium auditorum animis, etiam in componenda cantilena, quae singulis aequaliter arrideat, insuperabilis cerneretur difficultas. Nostra itaque nihil interest, unus ne an plures singularem quandam musicae vim in se sentiant, quandoquidem causam tantum, unde illa praecipue fluat, ostendere conemur. Kircherus, pag. 550, ad concitandos affectus hominum quatuor conditiones summe necessarias ponit, *Harmoniam* scilicet, *numerus seu proportionem*, *orationem* et *subjectum capax*. Quam illius observationem sic nos amplectimur,

syllables that were shorter than the short ones and longer than the long ones in order to teach singing? Since all music depends on an exact observation of times, and the more elements each syllable consists of, the more time it requires, in order to be suitably expressed, they thought that not even the nature of the syllables should be neglected, as if it was especially necessary for softening and exasperating the song.’ In the following he adduces the words from Dionysius of Halicarnassus: ὁδός, ῥόδος, τρόπος, et στροφή, in which, although anyone of the first syllables is pronounced as short, he teaches that a very evident discrimination of time is required in uttering each of them. He says that this regard paid to the syllables has brought about the entire matter of the *musica pathetica*, so that the saying ‘rhythm is everything for musicians’ hereby became a proverb among the ancients. Thereby he also presents an answer of this kind to the question of the nerveless music of today, in which he condemns the neglect of rhythm as the true expeller of this remarkable efficacy among the contemporary musicians. So he says on page 59: ‘Ever since a thousand years ago and more this great potency of agitating the affects has been neglected among the musicians, namely from the time when the use and knowledge of rhythm came to an end, which alone had been able to accomplish that, which no musician can accomplish in our time.’ Contemporary musicians can indeed find much in this most learned work, through which they shall understand that their art is reckoned to be, we do not say below the rank of the ancients, for they shall perhaps not dare to deny this, but that it is considered to be unworthy of it, when it is compared at least according to some standard. However it may be, we think that today’s music should not be deprived of its praise, although we gladly confess that it cannot rise to such heights, to which ancient music is exalted by its admirers.

Thesis 18.

It is so wide of the truth that we believe that we here sufficiently describe how much power the music of the contemporaries possesses for agitating the minds of men, that we rather firmly believe that this can hardly be determined in a proper way by anyone. Since this requires not only a perfect musician, but a complete knowledge of the minds of every single man and a notion of the different fancies in each and every man at different times, yes, their force and power is different at every single moment, it demands a constant observation of the affects. And even if all these facts were known, an unsurpassable difficulty would be noticed, just as in bringing the minds of all listeners to uniformity, also in composing a song that is equally pleasing to everyone. It is therefore of no interest to us, whether one or more persons feel any particular power of music in themselves, since we only try to demonstrate the cause, from whence it emanates in particular. Kircher on page 550 posits four conditions as highly necessary for agitating the affects of men, namely ‘harmony’, ‘number or proportion’, ‘speech’ and ‘a capable

ut ceteris conditionum loco habitis Harmoniam et numerum, seu temporis accuratam mensuram et proportionem, causam proximam istius effectus nuncupari debere modeste statuamus. Diversorum in diversis hominibus humorum harmoniae varietate varie commotorum (cujus rei experimentum in diversis liquoribus se fecisse Kircherus ostendit) alia est consideratio, siquidem gentes legimus incondito carmine et Barbaro ululato potius quam harmonia delectatas. Verborum quidem vim magnam esse fatemur, absque his tamen non solum instrumentali Musica homines valde afficiuntur, sed etiam bruta, teste ipso Kirchero, ad tibicinum cantum saltare solent. Adeo ut Tactus potentiam in hoc negotio praecipuam esse cognoscamus, id quod sic demonstratur: Sonus seu vibrationes tremuli aeris, prout fuerint vehementes, omnia quae circumstant corpora concutiunt, unde vibratus ille aer tam tympano quam spiritibus animalibus, quorum ope motus corporis singuli fiunt, similem sui motum imprimere valet. Jam vero omnes motus sonori hoc magis sunt jucundi, quo distinctius a mente percipiuntur, siquidem in his ea plenius sibi satisfaciat, quam in iis, qui confusa plurima habent. Quaecunque autem in sono sunt, ea certis atque justis temporum intervallis mensurata omnium optime distinguuntur. Neque enim dum in momento sonus fit, percipi, neque si nimis producitur, quanquam optima sit harmonia, placere potest. Quapropter exacta temporis mensura sonus circumscriptus occulta quadam vi animos hominum pro diversa complexione atque studiorum genere diversimode occupat. Nempe cum aer commotus tympanum auris ferit, spiritus animales excitati per suos meatus discurrunt, a singulis pulsibus pelliculae, quam diximus, novas concussionem accipientes. Qui si crassi fuerint et segnes, non usque adeo magnam menti voluptatem sistunt, siquidem ipsi tum aegre moveantur, ast ubi vividi ac subtiles, quales vino aliisque potulentorum generibus levati notantur, non solum animo distinctis ejusmodi vibrationibus satisfaciunt, sed exteriores quoque corporis partes ita commovent, ut quiescere vix possint. Certe si abfuerit metus indecori, in tripudia erumpant, interiores spirituum commotiones externis gestibus monstraturae. Imprimis Tripla, seu Tactus Trochaicus, id efficere solet, qui, ut de plebe, quae in conviviis suis non singulos Tactus, sed singulas eorum partes pedum continuis pulsibus distinguere solet, id quod ex lyra ista rusticorum, quam *Nyckelgiga* vocant, clarissime patet, nihil nunc dicamus, etiam in honoratioribus, ubi locus et tempus id permittant, suam vim frequentissime experitur.

subject'. We understand this observation of his in such a way, that while the others are considered as conditions we modestly state that harmony and number, or a correct measure and proportion of time, must be called the closest cause of this effect. Another is the consideration of the different humours in different men, which are differently agitated by the variety of harmony (into which matter Kircher shows that he has made an experiment in different liquids), since we read that people are delighted more from a disordered song and a barbarian wailing than from harmony. Admittedly we agree that the power of words is great, but without these not only men are much affected by instrumental music, but even beasts usually dance to the music of flute players, to which Kircher himself testifies. Thus we should acknowledge the special power of *tactus* in this matter, and this is explained like this: The sound or the trembling vibrations of the air shake all bodies that are around according to their intensity. Therefore this air in vibration is able to impress a motion that is similar to itself both on the ear-drum and on the living spirits, by the mediation of which all single motions of the body come about. Now all sounding motions are the more cheerful, the more distinctly they are perceived by the mind, since this is more content with these, than with those, in which many things are disordered. But whatever there is in sound, this is best of all distinguished when measured in fixed and proper intervals of time. For sound can neither be perceived when it occurs in a very short time, nor be pleasant if it is extended too far, even though the harmony be the best possible. Therefore a sound that is restricted by an exact measure of time in different ways takes possession of the minds of men by some unknown force, in accordance with their different complexions and kinds of fancies. For when agitated air strikes the ear-drum, the stirred living spirits rush along their paths, and receive new concussions from each beating of the membrane, as we call it. If these are thick and sluggish, they do not bring about such a great delight in the mind, since they themselves then move reluctantly, but when they are vivid and slender, which can be found when they are alleviated by wine and other kinds of drinks, they not only please the mind with distinct vibrations of this kind, but they also stir the outer parts of the body in such a way, that they can hardly come to rest. Assuredly, if there is no fear of disgrace, they burst out into dancing, in order to display the inner commotions of the spirits in external gestures. Above all the triple, or the trochaic *tactus*, usually has this effect, which very frequently proves its force also among the more honourable people, when place and time allow it, to say nothing now about the simple people, which at their feasts usually distinguish not each and every *tactus*, but every part of them, by continuous beatings with the feet, which is very evident from the keyed fiddle, which they call *Nyckelgiga*.

Thesis XIX.

In Tactu itaque praecipua Musicae vis et efficacia consistit, adeo ut, si e concentu aliquo exactam tollas temporis mensuram, tolli quoque necesse sit omnem gratiam ac melodiam. Finge cantilenas multarum vocum absque Tactu, et inconditum clamorem miseris auribus molestissimum habebis. Sed vero an ullus cantus hoc condimento praetermisso fingi possit, adeo dubitamus, ut etiam notissimas suavissimasque melodias hac sola ratione, non dicamus ignotas reddi, sed risui atque detestationibus exponi posse, certo sciamus. De saltationibus autem res est manifesta, ubi sublato Tactu non solum neminem ad tripudia excitare possis, sed etiam contra in actu saltandi occupatissimos sistere facili negotio queas. Quapropter optimo jure *Anima* totius Musicae Tactus salutatur, sine quo nihil suavitatis cantus, nihil delectationis instrumenta, ut ut polyplectra, habere possunt. Unde quod de Rythmo superius e Vossio diximus Tactui nunc nostro tribuere non dubitamus, eumque τὸ πᾶν παρὰ μουσικοῖς nuncupamus.

Thesis XX.

Id autem qua veritate a nobis dictum sit, varii isti tympana militaria (*pukor* et *trummor*) pulsandi modi demonstrant, ubi nulla sane aut exigua sonorum varietas admittitur, et tamen non solum diversae actiones, conflictus puta, receptus, vigiliarum, et quae sunt plures ejusmodi aliae, militibus imperantur, sed etiam ad illorum pulsum in quibusdam regionibus non incommode saltatur. Singuli enim Tympani pulsus adeo vehementer spiritus animales concutiunt, Tactusque partes adeo distincte exprimunt, ut qui saltat, nolit velit, ad illos se componere necessum habeat. De Castagnetis Mersennus, lib. 4, *de Campanis* scribit eas *Citharae Hispanicae adhiberi solitas esse, immo aliquos satis feliciter atque jucunde ad solum cantum Castagnetarum saltasse, ut in admirandis Hispanorum saltationibus ipse expertus est*. Et post pauca: *Nota vero, inquit, sonos a pollice medioque digito se mutuo prementibus editos in Castagnetarum locum saepenumero succedere*, ubi tamen in utroque instrumento nulla fere sonorum varietas deprehenditur. Unde verissimam Kircheri sententiam agnoscimus, qua Tactum una cum Semitonio animae loco in Musicis habet, cum non tantum circa acutum et grave in cantilenis ex semitonio, sed etiam ex solo Tactu incredibilis sit cantilenarum et vis et varietas. Id quod ita nos docet experientia, ut vix e re sit Gallicum Mersenni tractatum de hac re consulere, quo *militaris tympani cantus ad conventum, gradum*, etc., se complexum esse ipse libro, quem modo nominavimus, fatetur. Ubi *Gallorum militum gressus*

Thesis 19.

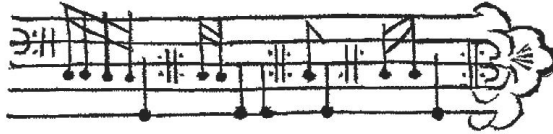
The special power and efficacy of music thus consists in the *tactus*. And thus, if you take away the exact measure of time from any consort, all charm and melody is necessarily taken away as well. Imagine songs with many voices without *tactus*, and you shall have a disordered clamour that is very annoying to our miserable ears. But whether any singing can be imagined without this seasoning, we doubt so much, that we know for sure that even very well-known and sweet melodies only for this reason, we should not say become unrecognizable, but can be exposed to laughter and hatred. As regards dances the case is clear. In these you not only cannot excite anyone to dance when *tactus* has been taken away, but on the contrary you can even easily halt those who are very much engaged in dancing. Therefore *tactus* is most rightfully greeted as the soul of all music, without which the singing can have no sweetness, the instruments no pleasure, however polyplectrous they might be. Therefore we now do not hesitate to now attribute that, which we said about rhythm above from Vossius, to our *tactus*, and we state that it is ‘everything for musicians’.

Thesis 20.

Those different ways of playing military drums (*pukor* and *trummor*), where none at all or a small variation of sounds is allowed, demonstrate with what truthfulness we said this, and still not only different actions, say fights, retreats, guards, and several others of the same kind, are commanded to the soldiers, but people even dance rather conveniently to their beating in some regions. For the beats of every single drum shake the living spirits so violently, and express the parts of the *tactus* so distinctly, that he who dances has to adapt himself to them, whether he wishes to or not. On castanets Mersenne writes in book 4, ‘On bells’, that they ‘are usually played together with the Spanish guitar, yes, that some people have danced very successfully and delightfully only to the playing of castanets, as he has experienced himself in the astonishing dances of the Spaniards.’ And shortly afterwards he says: ‘But notice that the sounds rendered from the thumb and the middle finger pressing upon each other oftentimes replace the castanets’, when in both instruments nevertheless almost no variation of the sounds can be detected. Thereby we acknowledge the very true opinion of Kircher, in which he holds *tactus* together with the semitone as the soul in musical matters, since the power and the variety of songs is incredible not only with regard to high and low in songs because of the semitone, but also from *tactus* alone. Experience teaches us this to such a degree, that it is hardly out of place to consult the French treatise of Mersenne on this matter, in which he declares that he has comprised ‘the playing of the military drum for assembly, pace’, etc. in the book that we recently mentioned. There he teaches ‘that the march of the French soldiers is directed by

Pyrrichi-Anapesto, Helvetiorum autem Jonico minore, aliorumque gradus Jambico vel Anapesto regi docet.

Pyrrichi-Anapestus; Jonicus minor; Jambicus; Anapestus.



Et porro eundem monet pedem censi, licet in unius temporis brevis locum 2, 4, 8, vel 16 tempora succedant, uti fit in compositionibus musicis, hae siquidem diminutiones pedem non mutant. Ne vero nostrorum militum heic obiliti videamur, cantus quosdam tympani militaris peditibus usitatos talibus quidem notis expressos adjungimus, quales ex pulsibus Tibicinis cujusdam in hac urbe, sed qui artem Tympanotribarum optime callet, percipere potuimus. Ex quibus cuivis patet non solam sonorum varietatem ad varias actiones suscipiendas militem hortari, sed tactus ejusque partium, seu pedum metricorum, diversitatem diversas in corpore spirituum concussiones, quibus in memoriam officii sui milites revocantur, excitare. Solum vero circa hanc rem monitum velimus nos vocabula ipsis tympanistis familiaria nostris rei militaris rudium explicationibus potiora duxisse.

Praeludium Universale



Sexies repetitus MARCHE



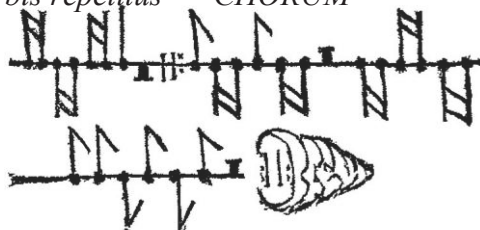
Rewalie Aftropp



Förgalringen

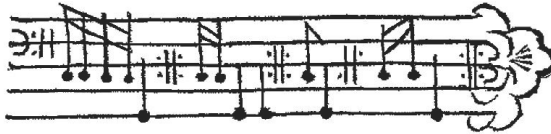


bis repetitus CHORUM



the pyrrhic anapaest, the march of the Swiss by the minor Jonian, and the pace of others by the iambus or the anapaest”.

Pyrrhic anapaest; Minor Jonian; Iambus; Anapaest.



And then he informs us ‘that it is considered to be the same foot, although 2, 4, 8 or 16 times take the place of one short time, as happens in musical compositions, since these diminutions do not change the foot’. But lest we seem to forget our soldiers here, we attach some tunes for the military drum that are used for the infantry. These are admittedly expressed with notes that we could perceive from the beats of a certain flautist in this town, but who is very experienced in the art of drummers. From this it is evident to anyone that not only the variation of sounds exhorts the soldier to undertake different actions, but that the diversity of the *tactus* and its parts, or metrical feet, excite different concussions of the spirits in the body, with which the soldiers are recalled to remember their duty. As regards this matter we only want to emphasize that we have considered the designations that are familiar to our drummers to be preferable to the explanations of people unexperienced in military matters.

General prelude



Repeated six times March



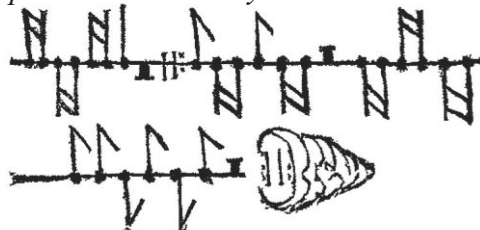
Reveille Marching off



Troop



Repeated twice Prayers



Thesis XXI.

Tanti vero Tactum Musicum Clarissimus Lipstorpheus facit, ut in *speciminibus Philosophiae Cartesii*, part. 3, pag. 206, idoneum, quo intervalla temporis atque motuum brevissimorum determinentur, illum iudicet. Cum tamen paulo superius Tychonem Brahaeum, incomparabilem Astronomorum sui aevi Phoenicem, aqua, arena, plumbo calcinato et argento vivo pluries exstillato usum, dimensionem temporis diu studuisse, inque ea occupatum, antequam horas praecise distinguere nosset, fatis functum esse doceat, modum autem, quo in hoc negotio utendum suadet, ipsius potius quam nostris eloquamur verbis: *Huic, inquit, bono eligendi essent tenues quidam albicantes et politi scipiones diversis eos uno eodemque tempore ad eosdem usus usurpantibus, ut tanto major sit observationum harmonia, tantoque melius discrimina evitarentur. Etenim quod ab uno forsitan peccaretur, alius resarciret et emendaret.* Hanc ille mensurandi rationem ita commendat, ut a modo illo Lobkovitzii, quem omnibus aliis mensuris palmam certitudinis praeripere arbitratur, primam eam nominet. Sed an extra sphaeram suam Tactus Musicus vagari volet, hinc dubitatio oritur, quod, cum funependula, utut accurata, propter aeris, qui nunc purior nunc crassior est, varietatem viris quibusdam eruditis se probare non potuerint, periculum sit ne Musicorum bacillis istis utentium lacerti saepius iterata manus positione et elatione lassentur atque languescant, et sic Chronometron, hoc nostrum inconstans inventum, non sine risu ad Musicam, ubi major libertas est, relegetur.

Interim tamen ab eruditissimo Lipstorphio excogitatum hunc modum non vulgarem esse illi dicent, qui facto ad mentem illius periculo, Musicorum illud moderamen, quo concentus suos feliciter dirigunt ac jucundissimos reddunt, etiam brevissimis motibus distinguendis utiliter adhiberi posse forte invenient.

DEO TRINUNI GLORIA

Thesis 21.

However, the most illustrious Lipstorp values the musical *tactus* so highly, that he in his *Specimens of Descartes's philosophy*, part 3, page 206, considers it to be suitable in order to determine the intervals of time and very small motions. But although he gives the information a little above that Tycho Brahe, the incomparable Phoenix of the astronomers in his age, by using water, sand, litharge of lead and mercury that had been dripping many times, had studied the dimension of time for a long time, and had died while being engaged in these matters, before he knew how to distinguish the hours exactly, we shall announce the method, which he recommends to be used in these matters, with his own words rather than with ours. He says: 'for this purpose some slender staffs that are white and polished should be selected by different people who make use of them to the same end at the same time, so that the harmony of the observations is the greater, and differences avoided in a better way. For the mistakes that one person would perhaps make, another would repair and improve.' He commends this method of measuring to such a degree, that he mentions it as the first after the method of Lobkowitz, which he considers to carry off the palm of victory as regards precision before all other measures. But the question arises hereby if the musical *tactus* does not want to diffuse itself outside of its sphere, since, seeing that the pendulums, however precise they may be, could not be approved of by some learned men, because of the variety of the air, which is now purer now thicker, there is a danger that the arms of the musicians that use these wands become tired and weak by the very often repeated lowering and raising of the hand, and that the chronometer, this fickle invention of ours, is thus not without laughter transferred to music, where there is a greater liberty.

But in the meantime those shall say that this method invented by the most learned Lipstorp is not of the common sort, who when they have made a trial in accordance with his intention shall perhaps find that this means of controlling the musicians, with which they successfully direct their consorts and make them delightful, can be suitably made use of also in distinguishing very small motions.

Glory to the triune Godhead

Viro Juveni
morum doctrinaeque laude politissimo
DOMINO OLAO RETZELIO
erudite de TEMPORE MUSICO
disserenti.

- 1 Credula gens veterum putat orbes esse reales,
 Atque Polos coeli dulce sonare melos,
 Gaudia coelicolis cantum perhibere sonorum,
 Et septem gyros edere posse Sonum.
- 5 Pro' dolor! In nugas sic stellifer axis abivit.
 Sed meliora docet pagina, Amice, Tua.
 O quoties tremulo demulces aëra tactu!
 O quoties fidibus pectora nostra levas!
 Flatibus Euterpe Tibi dulcem implevit avenam,
- 10 Cui Pana et silvas Tu resonare doces.
 Terpsichore blando meditatur carmina plectro,
 Cum Tibi tam doctae prodeat artis opus.
 Fac studeas MUSIS, MUSARUM MUSICA fecit,
 Ut vel MUSARUM Te canere ore putem.

Anno M. DC. XCVIII.
pridie iduum Novembris.

In fidae indelibataeque
amicitiae tesseram ap-
plaudere voluit,
debuit

Johannes Vallerius
Haraldi filius.

To the young man,
most refined with the merit of manners and learning,
Lord Olaus Retzelius,
when he disputes eruditely
on musical time.

- 1 The credulous ancient people considers the spheres to be real
and that the poles of heaven sound a sweet tune,
that the sonorous song grants joy to the inhabitants of heaven,
and that the seven circles can emit sound.
- 5 Alas! Thus the star-bearing vault has been transformed into nonsense,
but your book teaches better things, my friend.
O how often you stroke the air with your trembling *tactus*!
O how often you lighten our hearts with the lyre!
Euterpe has filled your sweet reed with breezes,
- 10 for her you teach Pan and the woods to resound.
Terpsichore designs songs with a charming plectrum,
when a work of such a learned knowledge appears from you.
Make sure you devote yourself to the Muses. The music of the Muses
has made me think that even you sing with the voice of the Muses.

In the year 1698,
the day before the Ides of November.

As a sign of faithful and
unimpaired friendship Johannes
Vallerius, the son of Harald,
wanted, and was obliged to
applaud.

Ad ornatissimum Juvenem
Dominum OLAUM RETZELIUM
cum egregiam dissertationem suam
De
TACTU MUSICO
ederet.

- 1 Musica Pellaeo quondam bene culta Tyranno,
Musica magnanimis semper amata viris.
Heroum mentes demulsit pectine Chiron,
Atque animum cepit, fortis Achille, Tuum.
- 5 Quid mirum? Amphion citharae dulcedine Thebas
Movit, et exstruxit moenia tanta sono.
Auritas fertur silvas Rhodopejus heros
Flexanimaque feras detinuisse lyra.
Haec eadem molli describens murmura Tactu,
- 10 RETZELI, fidibus pectora nostra moves.
Et Tua victurae commendant nomina chartae,
Dum celebrat blandis Te Tua lingua sonis.

S. HALLENBERG

To the most excellent young man
Lord Olaus Retzelius,
when he published his splendid dissertation
on
musical *tactus*.

- 1 Music was once much cherished by the Pellaeon ruler,
music has always been loved by brave-hearted men.
Chiron softened the minds of heroes with his lyre,
and captured your soul, brave Achilles.
- 5 What wonder? Amphion moved the Thebans with the sweetness
of his lute, and erected so great walls with the sound.
It is said that the Rhodopean hero detained listening woods
and beasts with his heart-moving lyre.
When you describe this same murmur with a gentle *tactus*,
- 10 Retzelius, you move our hearts with your lyre.
And your victorious writings commend your name,
while your voice makes you known by its pleasant sounds.

S. Hallenberg

4.2 Structure and Contents

Title

Dedication

Theses

1–6: Sound and its properties.

1–2: The great capacity of hearing. Sound is a trembling motion of a sounding body and air, which is stirred by an external force. References to Mersenne, and to Vallerius's dissertation *De sono*.

3–6: The three dimensions of sound are duration (*longitudo*), volume (*latitudo*) and pitch (*profunditas*). These terms are defined.

7–16: The musical *tactus*.

7: Definition of *tactus*. The division of sound into intervals, i.e. a fixed measure of time, usually marked out by the lowering and the raising of the hand. The subject of the song calls for *battute* that are now slower, now quicker.

8: Old methods of measuring – the signs of prolation and their usage.

9–15: The musical *tactus* is either spondaic or trochaic, since duple and triple proportions are the most obvious to our senses.

10: Spondaic *tactus* is slow and eminent, suitable to solemn and sacred subjects.

11–12: The trochaic is much more diverse, made up of a triple proportion, being unequal by nature. Great difference in the usage of this *tactus* between simple and skilful musicians.

13–15: Comparisons. Greater variety of time in the trochaic than in the spondaic *tactus*. The function of fractions.

16: *Tactus* is little treated by earlier authors, and only confusedly.

17–20: The power of *tactus*.

17–20: Music stirs the affects. The importance of *tactus* in this respect, with ancient models. Account of arguments. *Tactus* is the soul of all music. The usage of military drums attests to that.

21: Final diversion.

Lipstorp's method of measuring time is rejected.

Gratulatio 1

Gratulatio 2

4.3 Commentary

Title:

MUSICA] Note that the previous dissertations were both labelled as *disputationes physico-musicae*, the first and the second. This dissertation differs from the pattern in this respect as well.

DE TACTU] The importance of the *tactus* in music has been stressed several times in the previous dissertations, e.g. in the passage of the last thesis of *De sono*, which was later quoted in the first thesis of *De modis*. The subject of the third dissertation is thus to be expected, if we also consider the words in the last thesis of *De modis*, where it is promised that we will later be presented with the true causes of the power of music to rouse the affects.

Moreover, Vallerius seems to have paid special attention to this very subject. In Upmarck's funeral oration we are given the information that he even held private lectures on the relation between poetry and music, and about the successful union of their respective feet, rhythms and measures (Upmarck 1729, p. 124):

Cur [tacebo] privatis praelectionibus institutam juventutem circa Poëtices musiquesque amicum foedus, circa utriusque artis pedes, Rhythmos, modosque feliciter jungendos?

The special attention given to *tactus* in music in the circles around Harald Vallerius is not only reflected in *De tactu*. In the *Dissertatio gradualis de antiqua et medii aevi musica*, defended by Harald's son Georg under the presidency of Johan A. Bellman in 1706, there is on pp. 62 ff. an important section dealing with the relation between poetry and music that is based on the ideas of Isaac Vossius, but that treatment also contains some additional information. It is, for instance, there stated (p. 65) that the poetical feet correspond to the *tactus* in music (*pes apud Poëtas Tactui apud Musicos respondeat*), whereafter (pp. 66 ff.) the poetical feet are divided into certain categories depending on which affects they rouse. The iambus, for instance, is warlike and irascible (*bellicus* and *iracundus*), while the trochee is soft and enervated (*mollis* and *elumbis*). Finally (pp. 76 ff.) it is there explained what the nature and potency of rhythm is and consists of. Worth noticing is, however (p. 82), that it is not only *tactus* that rouses the affects. So does also harmony, for instance, and (pp. 84 f.) the words of the songs, and these should therefore be pronounced very carefully.

Upsalensi] Both previous dissertations spelt *Upsaliensis*. The variation mirrors usage at the time, where *Upsala* and *Upsalia* both occur. The latter, however, becomes the regular form at the end of the 17th century (Helander 2004, pp. 283 f.).

Geometriae] The constitutions of Uppsala university of 1655 stipulate that there should be two chairs in mathematics, one ‘euclidian’ and one ‘ptolemaic’. While the former comprised the ‘pure’ mathematics, i.e. geometry and arithmetic, the latter mainly concerned astronomy, and was regarded as the more important (Lindroth 1975 [II], pp. 468 ff.; Rodhe 2002, p. 12). Vallerius held the former professorship. Moreover, geometric proof was dominant within mathematics at the time, as several scholars have observed (cf. e.g. Goldstein 2000, p. 36).

OLAUS RETZELIUS] Olaus Magni Retzelius was born in 1671 as the son of Magnus Colopontanus, vicar in Odensvi in Östergötland, the same region of Sweden as that which Vallerius came from. He matriculated at Uppsala University on 27 May 1691 (*Uppsala universitets matrikel*, vol. 1, p. 339), received a musical scholarship from the consistory in 1696 together with Harald Vallerius’s son Johannes and six other students (*Akademiska konsistoriets protokoll*, XXI, p. 349), and won the master’s degree in 1700, having defended the dissertation *De pactis cum barbaris* under the presidency of Johannes Reftelius (Lidén 1778, p. 389). He wrote a congratulatory address to Harald Vallerius’s son Georg, when Georg was about to defend the *Exercitium philosophicum de tarantula* (1702). Retzelius later married Harald’s daughter Christina in 1708, as can be seen from preserved wedding poetry, where we likewise find Johannes Vallerius as one of the authors. In 1703 he was clerk at *Svea hovrätt* (Svea court of appeal) in Stockholm, and in 1708 secretary at *Sjötulldirektionen* (the board of sea customs). He died in 1732. (Odén 1902, p. 101).

Dedication:

HAQUINO SPEGEL] Haquin Spegel (1645–1714) is without doubt one of the most important ecclesiastical characters in Caroline Sweden. Having won the master’s degree in Lund in 1671, after several years of studies abroad, Spegel was eventually ordained in Strängnäs the same year, and became the chaplain of the Queen Dowager Hedvig Eleonora. In 1675 he became chaplain of the king, and in 1680 superintendent of Gotland. Finally he was appointed bishop of Skara in 1685, bishop of Linköping in 1692, and archbishop and vice-chancellor of Uppsala university in 1711. In 1693 he had won the degree of doctor of theology. He participated in the work with the canon law, the school regulations, and the revision of the bible and the hymnal of 1695, among other things. He was also a skilful poet and author of hymns. His posthumous reputation in Linköping was great, not least through the impact of the chronicles of Andreas Rhyzelius (Åsbrink & Westman 1935, pp. 304 ff.; *Svenska män och kvinnor*, s.v. *Spegel, Haquin*).

exercitio huic meo, ut ut rudi ac impolito] As indicated here, the dissertation was Retzelius’s first, i.e. the *pro exercitio*. Two years later, he won

the master's degree with another dissertation. And just as in Vallerius's dedication to De la Gardie in the *De sono* above (see the comments), we meet a *recusatio* together with that information.

Titulo] In this context, the word obviously refers to the dedication. In Classical Latin both *titulus* (OLD, s.v. *titulus*, 3) and *inscriptio* (OLD, s.v. *inscriptio*, 2, b) are used about the title of a book. But *inscribere* (OLD, s.v. *inscribo*, 2) is also the verb used for 'dedicating'. Noltinius (col. 1528) thus even renders the sentences *inscribere alicui litteras* and *titulum epistolae scribere* as equivalents.

chartaceo munere] Noltinius (col. 459) says that almost nothing else is as common as this phrase in dedications by young writers (*quo nihil fere in dedicationibus apud litteratos juvenes vulgatus est*). Nevertheless he rejects *chartaceus* as bad Latin, since it is first attested in late antiquity (TLL, Blaise [1]).

nec sua ex tenuitate, sed animo offerentis] The idea is a commonplace in dedications, and it is often supported by the biblical story in Mark 12:41–44 and Luke 21:1–4 on the poor widow who offers all she has (see further Sjökvist 2007, pp. 289 f.).

de coetu Christi ... meritus] i.e. certainly Spegel's ecclesiastical career as a clergyman and a bishop.

Theses:

1. **objectum auditus, seu sonus]** Cf. the commentary under the lemma *qualitas audibilis* in *De sono* above.

fibrae ... filamenta] Both words are medical *termini technici* at the time (Blancaert 1748, s.v. *fibra*; DMLBS, s.v. *filamentum*, and OED, s.v. *filament*, 1, a), and still in use today (Dorland's *Illustrated Medical Dictionary*, s.v. *fibra* and *filament*). In ancient Latin *filamentum* is only found in Paul. Fest. p. 81 and p. 113 (TLL), about a kind of fillet worn by priests.

affectionem] Any associations to the *Affektenlehre* should here be avoided. Retzelius uses *affectio* in the active sense, and this was rather unusual in ancient Latin. Cicero's use of it in *top.* 68 was probably crucial for the later development (cf. TLL, s.v. *affectio*, 1176, 80 ff.):

Comparantur igitur ea quae aut maiora aut minora aut paria dicuntur; in quibus spectantur haec: numerus, species, vis, quaedam etiam ad res aliquas affectio.

Among the scholastics, it becomes a philosophical *terminus technicus* (Blaise [2]). For the sense in which it was used among Retzelius's contemporaries, cf. e.g. OED, s.v. *affection*, III; but especially Micraelius 1659, cols. 69 ff., where we among other things can read that '*Affectiones* are thus in the sciences, for example in physics, always essential

properties, which emanate from the essence of the thing, just like heat from fire, and therefore they do not constitute an *unum per se* with its subject, but only an *unum per accidens*' (col. 71):

Affectiones igitur in scientiis, ut in physicis, semper sunt proprietates essentiales, quae ex essentia rei fluunt, sicuti calor ex igne, et propterea non constituunt cum subjecto suo unum per se, sed tantum unum per accidens.

In this sense the word is also used in Mersenne, for instance, in the words *nobiles proprietates, seu affectiones* (Mersenne 1648, p. 82). In Vallerius's *Disputatio physica de qualitatibus corporum naturalium* (1700), we meet as the very first words (p. 1): *De corporum qualitatibus seu affectionibus ... constituimus*, where *qualitas* and *affectio* are thus considered as equivalents. Also worth noticing, however, is that *affectio* in Burmeister is rather used about a musical period (1993[1606], p. 1069: *ad melodiarum affectiones (hoc est periodos) terminandum*.

qui nostri ingenii modulus est] The correlate is included in the relative clause. The final three clauses of the sentence should thus be understood as: *etsi non nisi unam ejus affectionem eo modulo, qui nostri ingenii est, heic metiri cogitemus*. Cf. Vallerius's *Disputatio physica de atmosphaera terrae* (1699), where we meet the similar (p. 79): *pro modulo ingenii nostri, breviter ita declaravimus*.

2. **Sonus extra sensationem]** What follows in this second thesis is nothing less than a summary of the definition of sound as it was presented in the *De sono* dissertation above (primarily theses 1–7). This is mirrored not only in the content, but also in the phraseology and the choice of words.

undulationes] The word seems to be a neo-Latin coinage, appearing in scientific contexts. It can for example be attested in Latin in letters by Isaac Newton (see the *Philosophical Transactions of the Royal Society of London*, no. 85 [15 July 1672], p. 5017), but also in English scientific discourse of the time (*OED*, s.v. *undulation*).

absque] The *absque* in the sense of *sine* occurs in early Latin, and later on also as archaisms in some Classical writers. In late Latin it became very common, as it is in factual neo-Latin texts as well (Östlund 2000, p. 50). Krebs & Schmalz think it should be avoided, and question the attested readings of the word in for instance Cicero, readings that Noltenius (col. 784) also referred to. Notably, this word is found five times in *De tactu*, but does not occur at all in *De sono* or *De modis*.

Mersennum de Natura sonorum] The reference apparently goes to the first book in Marin Mersenne's *Harmonicorum libri XII* (1648), the title of which is (p. 1): *De natura, et proprietatibus sonorum*.

Praesidis nostri de Sono disputationem] The reference to Vallerius's dissertation *De sono* informs us about several matters of importance. The

first is the explicit statement that Vallerius's dissertation summarizes Mersenne's ideas as they are presented in the first book of *Harmonicorum libri*. If we had any reason at all to doubt Vallerius's dependence on Mersenne, this has made it all clear. The second is that Vallerius has obviously presented his own treatise on sound to be used in the teaching of Retzelius. This function is often underestimated in discussions concerning older dissertations (cf. Lindberg 2006, pp. 119 f. and 125). The third is that Retzelius refers to the *De sono* dissertation as Vallerius's work, a fact that, together with the other circumstances discussed in a separate section above, suggests that there were two different authors, and thus gives some indications on who actually wrote both dissertations.

3. **Tria vero in sono invenimus ...]** The three properties mentioned are all defined in *De sono*. They are also there treated as the three essential ones, e.g. in the first sentence of thesis 68.

corpus] The word is here referred to as a philosophical *terminus technicus*, explained in Micraelius as 'a natural substance that has both an active and a passive nature, i.e. *forma* and *materia* (1661, col. 334):

Corpus physicum in praedicamento substantiae est naturalis substantia habens naturam tam activam quam passivam, i.e. formam et materiam.

The use of the designations for the three spatial dimensions should not lead us to think that sound is something that has *forma* and *materia*, Retzelius stresses. The remark might seem somewhat superfluous to a modern ear, but it is in fact a repudiation of the Aristotelian concept of sound as physical bodies striking on one another, which had been so immensely influential both in antiquity and in the Middle Ages (cf. e.g. Hunt 1978, pp. 19 ff., and Burnett 1991, pp. 43 ff.).

modum] Also this word belongs to philosophical technical terminology, and has there a sense close to 'property' or 'attribute' (cf. Blaise [2], s.v. *modus*, 4; *DMLBS*, s.v. *modus*, 9; and *OED*, s.v. *mode*, 6, a). Micraelius (1661, col. 783) explains it as *rei determinatio et certa habitudo, qua res aliter atque aliter obtinet essentiam, e.g. sive actu sive potentia*. And somewhat later: *modus dicitur alias affectio, attributum et passio entis*.

4. **Mersennus lib. 2, de causis sonorum, prop. 30]** The heading of prop. 30 in book 2 (*De causis sonorum seu De corporibus sonum producentibus*), of Mersenne's *Harmonicorum libri XII* (1648, p. 24) is: *Durationem recursuum chordae datae definire, id est tempus assignare, quo periodus integra recursuum, seu totalis chordae motus durat* ('to define the duration of the movements of a given string, i.e. to assign a time, during which a complete period of movements, or a complete motion of a string, lasts'). We see some obvious echoes from it in the first sentence in this thesis. In

the proposition itself, Mersenne then writes: *nullus sensus potest ultimos nervi cursus observare* ('no sense can observe the last movements of the string'). He continues by saying that he 'has observed that a chord of hemp of 45 feet, and its duple, that is stretched with two pounds produces one hundred movements that are almost equal to one hundred seconds, and when it is stretched with 8 1/3 pounds, it completes 200 movements in the same space of time':

... observavi in chorda cannabina ... 45 pedum, et illius dupla, quae duabus libris tensa centum recursus facit, centum minutis secundis proxime aequales, quae cum a libris 8 1/3 tenditur, eodem spatio temporis 200 recursus perficit.

5. **Mersennus, lib. 2, prop. 39]** The reference goes to Mersenne's *Harmonicarum libri* (1648), p. 31, where proposition 39 has the heading *Sphaeram soni dati definire, hoc est spatium assignare, a quo sonus datus audiri potest* ('to define the sphere of a given sound, i.e. to assign the distance, at which a given sound can be heard'). In its first section, Mersenne explicitly deals with the 'greatest sounds', based on his own experiences, related in five examples. During the siege of La Rochelle (1627–1628), for instance, the whistling from the cannonballs had been heard at the distance of 3000 paces. On another occasion, at a calm night under a clear sky, the noise of muskets was heard at the distance of 8000 paces. However, Mersenne leaves the question of whether the sound of strings and the other sounds mentioned here could be measured according to same principles to be answered by other scholars. As we can see later in this section, Retzelius questions the possibility of this investigation to be carried out in practice.

fides] Walther explains it primarily as *Saiten*, with the addition *it. allerhand besaitete Instrumente* (cf. JPG and BFS). In Praetorius (1619, II, p. 4) it is mentioned as one name of the violin.

fides pulsandum vel vocem intendendum] As regards the impersonal gerundive with an object in the accusative, a construction that is mainly pre-Classical, cf. K.-St., I, pp. 734 f., see also the commentary on thesis 14 below.

Forte et Piano] As it seems, *forte* was first introduced as a musical technical term by Giovanni Gabrieli at the end of the 16th century, and then it most often meant a return to normal dynamics (*GMO*). Walther, however, explains it as *starck, hefftig, jedoch auf eine natürliche Art, ohne die Stimme, oder das Instrument gar zu sehr zu zwingen*. Orostander's contemporary primer says: *Forte requirit vocem effferri cum vehementia* (Lundberg & Sjökvist 2010, p. 86).

The *piano*, however, at first signified an echo effect (*GMO*, s.v. *piano* (*i*)). In Walther it is described as *so viel als leise; dass man nehmlich die Stärcke der Stimme oder des Instruments dermassen lieblich machen,*

oder mindern soll, dass es wie ein Echo lasse. Orostander's contemporary primer says: *Piano, piu piano, pianissimo, vocem urget submissam et tenuem* (Lundberg & Sjökvist 2010, p. 86). As Retzelius defines the terms here, they are certainly closest to Orostander. On the general history of dynamics, see *MGG*, vol. 2, cols. 1608 ff.

6. **accuratissimis]** In ancient Latin the word *accuratus* was not used in the active sense about people, but only in the passive about things (L&S). Krebs & Schmalz thus reject the usage.
- convenientiam quandam vibrationum]** Behind the description of consonance is once again the *coincidence theory*. See the commentary on thesis 72 of *De sono* above.
- praeter Mersennum]** Mersenne in the *Harmonicorum libri XII* (1648) primarily deals with these matters in propositions 35 and 36 of the second book (pp. 27 ff.).
- Disputatio de sono]** Vallerius primarily treated the question of pitch as depending on the frequency of the vibrations in thesis 34, and consonance in thesis 71–74 of *De sono*.
7. **quo]** The *quo* as a final conjunction, as an equivalent to *ut*, was in Classical Latin considered as characteristic of poetical usage (Sz., p. 79).
- manus depressione et elevatione]** Allegedly, the notion of the movement of the hand as the measure of time in music was first discussed in detail by Adam von Fulda at the end of the 15th century, and it remained important until the 18th century (*GMO*, s.v. *tactus*). It was also used in the education of beginners in music theory, as exemplified in Orostander's primer from 1699 and 1703 (see Lundberg & Sjökvist 2010, p. 72)
- Cartesius in compendio Musico]** The passage referred to can be found in the chapter *De numero vel tempore in sonis observando* in Descartes's *Musicae Compendium*. As can be seen, Retzelius has more or less summarized Descartes's words (1978, pp. 6 ff.):

Pauci autem advertunt, quo pacto haec mensura sive battuta in musica valde diminuta et multarum vocum auribus exhibeatur, quod dico fieri tantum quadam spiritus intensione in vocali musica, vel tactus in instrumentis, ita ut initio cujusque battutae distinctius sonus emittatur: quod naturaliter observant cantores et qui ludunt instrumentis, praecipue in cantilenis, ad quarum numeros solemus saltare et tripudiare: haec enim regula ibi servatur, ut singulis corporis motibus, singulas musicae battutas distinguamus, ad quod agendum etiam naturaliter impellimur a Musica: certum enim est sonum omnia corpora circumquaque concutere, ut advertitur in campanis et tonitru, cujus rationem Physicis relinquo: sed cum hoc in confesso sit, et, ut diximus, initio cujusque mensurae fortius et distinctius, sonus emittatur, dicendum est etiam illum fortius spiritus nostros concutere a quibus ad motum excitamur, unde sequitur etiam feras posse saltare ad numerum si doceantur et assuescant, quia ad id naturali tantum impetu opus est.

Manus Musicae Guidonianae] The Guidonian hand, on which the singing syllables were placed, was allegedly invented by Guido d'Arezzo (early 11th century) as a method of training singers in solmization (*GMO*, s.v. *solmization*, I, 1; cf. Walther, s.v. *mano harmonica*; and *MGG*, vol. 8, cols. 1561 ff.).

Mersennus, lib. 6] Mersenne explains the Guidonian scale and hand in proposition 14 of book 6 in his *Harmonicorum libri XII* (1648, pp. 100 ff.). The quotation can be found on p. 101, and has here been somewhat adjusted. In Mersenne it is: *Nunc autem mensura vocetur spatium temporis, quo semel pulsat teria [sic], vel potius secundum horae minutum labitur* ('now, however, the measure may be called the space of time during which the artery beats once, or rather a second passes'). To describe the speed of the *tactus* with the pulse of the body is generally common in the 17th century (Houle 1987, pp. 3 ff.).

lib. 7 de cantibus ex Alberto Bannio] The full title of book 7 of Mersenne's *Harmonicorum libri XII* (1648) is *De cantibus, seu cantilenis, earumque numero, partibus, et speciebus* ('on songs and their number, parts and species').

On pp. 153 ff. of that book, Mersenne deals with the ideas of the Dutch music theorist and composer Joan Albert Ban (1597 or 1598–1644), who during 20 years worked with his *musica flexanima*, a system in which 'the text was expressed musically by means of specific intervals, harmonics and rhythms' (*GMO*, s.v. *Ban, Joan Albert*). From the fourteen different numbered sections of Mersenne's account, Retzelius here combines no. 2 and no. 8. This former is (p. 153):

Lenta admodum constituenda est Temporis aequalis mensura, ad eam nempe tarditatem producta, ut quatuor fusae singulis syllabis aptatae nullo negotio, hoc est clare et distincte faciliterque sine confusione pronuntiari, et intelligibiliter audiri queant ...

while the latter is (pp. 153 f.):

Lenta admodum semper servanda est mensura, quae licet interdum velocior designetur, in acceleratione semper est cautela adhibenda, ne verborum aut syllabarum iusta pronuntiatio perceptione quoque modo impediatur.

The difficulties with diminution that Retzelius accounts for thereafter correspond with Ban's advice, but does not follow his line of thought especially closely. While Ban still focuses on pronunciation, Retzelius, as we can see, brings into discussion the risk of increasing the tempo.

Moreover, there is also a direct link here from Retzelius's dissertation to Orostander's contemporary *Compendium musicum*. In the latter, a primer intended for practical usage, the importance of clear pronunciation is strongly stressed (see Lundberg & Sjökvist 2010, p. 72).

Symphoniis et Sonatis] Neither of the terms can be defined with precision at this time. In the 17th century, *symphonia* could refer to several kinds of musical pieces, which were most often performed by instrumental ensembles (cf. Walther; Praetorius 1619, III, p. 24; and Kircher 1650, vol. 1, p. 592). However, in the last quarter of that century, ‘the term “sinfonia” or one of its equivalents was used interchangeably with the equally ambiguous “sonata”’ (*GMO*, s.v. *sinfonia* (i); cf. *MGG*, vol. 9, cols. 15 ff.). Also regarding the *sonata* it can be stated, though, that it was almost always used about instrumental music (*GMO*, and Praetorius 1619, III, p. 24), and especially about violin pieces that are made up of alternating adagio- and allegro-parts (Walther, see further *HMT*; and *MGG*, vol. 8, cols. 1573 ff.).

Adagio atque Allegro] In Praetorius (1619, III, pp. 51, and 244) *adagio* is explained as meaning *tarde* (‘slowly’). Walther likewise translates it as *langsam* (cf. *GMO*). Orostander’s contemporary primer says: *Adagio seu lente incessum designat tardum et gravem* (Lundberg & Sjökvist 2010, p. 86).

The *allegro* is thus presumably, considering the sense of *adagio*, here to be primarily understood as an indication of swift tempo, rather than of a merry mood. The latter sense had been common in earlier music, though, and can be still attested in the 18th century (*GMO*). Walther, for instance, states that it is derived from the Latin word *alacer* (‘lively’), and explains it as *fröhlich, lustig, wohl belebt oder erweckt; sehr oft auch: geschwinde und flüchtig*. Orostander’s contemporary primer likewise says that it indicates a course that is somewhat swifter, although merry: *Allegro cursum intendit aliquanto celeriores, tamen hilarem* (Lundberg & Sjökvist 2010, p. 86). On the general history of tempo, and its designations, see *MGG*, vol. 9, cols. 447 ff.

8. **prolationum]** As a musical technical term, *prolatio* is first attested in the 6th century. From the 14th century it is closely associated with mensural notation, where it more precisely concerns the relationship between the minim and the semibreve. At the turn of the century 1400, however, the word was also used in the sense of *mensura*, as a concept covering *modus* and *tempus* as well as *prolatio* (*HMT*, s.v. *prolatio*, III; and *GMO*, s.v. *notation*, §III, 3, (iii); cf. *MGG*, vol. 7, cols. 323 ff.), and this is obviously the case in this thesis, hence the translation.

Among the mensural signs depicted in this thesis, practical usage was almost always limited to the circle denoting *tempus perfectum* and to the half-circle denoting *tempus imperfectum*, in which a dot in the center meant a *prolatio major*, and its absence a *prolatio minor* (*GMO*, s.v. *notation*, §III, 3, (iii), see further *HMT*, s.v. *prolatio*; and Busse Berger 1993).

cantilenas ... minutas] The *minutas* should probably be understood as *diminutas*, although I have not been able to attest this sense of the word in

musical contexts. The *cantilena minutae* are thus songs in which diminution (a long note is replaced by notes of shorter value) has taken place (see the commentary on *Musica diminuta* in thesis 68 of *De sono* above).

minimis] Admittedly, the *minima* is also the name of a note, viz. the minim, which is first found in early 14th century notation (*HMT*; *GMO*, s.v. *minim*; and *MGG*, vol. 7, cols. 324 ff.; cf. *DMLBS*, s.v. *minimus*, 5; *LLNMA*, s.v. *parvus*, I, C, 1, b). But Retzelius must be thinking of notes with very small values in general, rather than this specific note. Later in this thesis, he also specifies the notes that the ancient musicians were lacking as the minim, the crotchet, the quaver and the semiquaver.

Kircherus, lib. 10, de Tempore Musico, pag. 676] The reference is not really correct, for the passage referred to can be found in chapter 10 of book 7 in Kircher's *Musurgia universalis* (1650, vol. 1, p. 676). The heading of the chapter is *De Tempore Musico, Signis et Numeris quibus tum Antiqui, tum Moderni id exprimunt* ('on musical time, signs and numbers, with which both the ancients and the moderns express it'), and just as Retzelius says, the same mensural signs are depicted there as in his own.

proportionibus] The word is a *terminus technicus* in medieval mensural notation. As we can see, Retzelius primarily explains it as the mensural relationship between different note values (see further *GMO*, s.v. *proportional notation*, 3).

signum contra signum] This way of singing, which means that different mensural signs are used at the same time for different parts of the same composition, is for instance explained in greater detail in Petrus Aaron's *De institutione harmonica* (1516, fols. Ev ff.), in the chapter with the title *Quomodo index contra indicem, id est signum contra signum, ut dicitur, cani debeat* (where the word *index* is used in the sense of 'mensural sign'). Kircher accordingly also describes the feature as when both voices at one and the same time bring forth prolations of different proportions (1650, vol. 1, p. 680):

... dum utraque vox ad unum et idem tempus duas diversae proportionis prolaciones profert, quam Musici sensatiores vocant, cantare signum contra signum.

minimas jam notas et semiminimas, fusas ac semifusas] While the *semiminima*, like the *minima*, is first found in the 14th century, the *fusa* and the *semifusa* are first attested in the 15th century (*GMO*, s.v. *minim*, *crotchet*, *quaver*, *semiquaver*; and *MGG*, vol. 7, cols. 324 ff.; cf. *LLNMA*, s.v. *semiminima*). In Bellman / Vallerius (1706, p. 15), however, these notes are all attributed to Johannes de Muris (beginning of 14th century). Their values have differed in history, but for Retzelius they apparently correspond to our modern usage, as can be seen for example in the

definitions in Orostander's *Compendium musicum* (Lundberg & Sjökvist 2010, p. 78, cf. Walther).

teste Kircheri, pag. 683] The reference is to book seven of Kircher's *Musurgia universalis* (1650, vol. 1, p. 683), the same chapter as was mentioned above. Just as Retzelius says, Kircher there stresses that the ancients were lacking the notes mentioned.

Kircheri verbis Artis Magnae, p. 683] The quotation has been taken literally from the same page as above in book seven of Kircher's *Musurgia universalis* (1650, vol. 1, p. 683).

In temporis vero perfecti sive ternarii, aut sesquialtera prolatione] The *tempus perfectum* is triple, since the number three cannot be divided. It is thus more perfect than number two (Walther, s.v. *perfetto*). In this time, one brevis was equivalent to three semibreves (Walther, s.v. *tempo perfetto*; see further *HMT*, s.v. *prolatio*, II, 1; and *MGG*, vol. 7, cols. 324 ff.).

The *sesquialtera* proportion, which was the most common, in mensural notation meant that the value of each note was diminished in the ratio 3:2. Often only the number 3 (*numerus ternarius*) was used to indicate it (*GMO*, s.v. *sesquialtera*). For some examples of the sesquialter proportion indicated both with the number 3 and the number 2 (*numerus ternarius cum binario*), see Walther, p. 566.

9. **vel Spondaicum vel Trochaicum]** As Retzelius says, the designations have been borrowed from the metrical feet in poetry. While the spondaic advances with a spondee or a dactyl, the trochaic does so with a trochee, a iambus, or a tribrach (Bellman / Vallerius 1706, pp. 30 f.). In Gezelius (1672, p. 572) the spondaic is also called *aequalis*, while the trochaic is called *inaequalis*.

proportio dupla et tripla ... Musicis sufficientissima] Cf. Kircher 1650, vol. 1, pp. 682, where he states that all prolations can be reduced to only two species of time, to the binary and the ternary:

Cum enim omnes prolationes musicae ad duas tantum temporum species, id est, ad binarium et ternarium revocari possint ... frustra per plura fit, quod per pauciora fieri potest.

10. **plausus]** Walther, with a reference to book 2, chapter 10, of Augustine's *De musica*, explains the word as *der Tact, oder vielmehr das mit der Hand zu gebende Zeichen desselben* (cf. *TLL*, s.v. *plausus*, 2373, 34 ff.; and *MGG*, vol. 8, cols. 259 f.). See also Bellman / Vallerius (1706, p. 32): *Tactus, si manus vel pedis elatione aut positione a Praeceptore designentur ... plausus, et ab Italis Battute dicuntur* ('*tactus* are, if they are marked out with the raising and lowering of the hand or the foot, called *plausus*, and in Italian they are called *battute*'), as well as Kircher

(1650, vol. 2, p. 52): *Itali vocant la battuta, Boetius plausum, alij tactum et mensuram.*

paragrapho] The word, from the Greek παράγραφος, first appears in late Latin (Blaise [1], *TLL*), for a sign that separates different sections. In the sense of our modern ‘paragraph’, it is first attested in medieval Latin (Blaise [2], *DMLBS*, s.v. *paragraphus*, 2). Interestingly, neither Noltinius (cols. 1628 f.) nor Krebs & Schmalz disapprove of its usage. While Noltinius only discusses which gender it must be considered to belong to, Krebs & Schmalz actually defends its usage, since there is no old word that suits well enough to be used in the modern sense.

Vossius in ... de Viribus Rythmi, p. 86 et 130] The reference is to the Dutch scholar and philologist Isaac Vossius (1618–1689), *De poematum cantu et viribus rythmi* (1673), pp. 86 and 130 (for a general summary of this work of Vossius, see Hüschen 1968, pp. 342 ff.). In the first of these Vossius states that no other *tactus* is used in music at the time than the *mensura quadrata*, which represents the double spondee, and the sesquialter or the triple, which represents the tribrach:

... in tota hujus temporis musica, nullus alius frequentetur plausus, praeter mensuram quadratam quae dispondeum si sola spectes tempora, et praeterea sesquialteram aut triplam vulgo dictam, quae ... tribrachyn repraesentat.

At the second instance (p. 130), Vossius claims that musicians, if they want to restore the ancient music or correct the contemporary, must bring the ancient poetical feet back into music. Music of the time lacks them completely, he continues, but once again with the exception of the double spondee and the tribrach.

Ut est ille ..., ut ... extollat] We would here rather have expected for example an *ita est ille ..., ut ... extollat*. One possibility is that we have to do with a contamination of an exclamatory *ut* with the indicative, and a consecutive adverbial subordinate clause.

antiquae Musicae praestantiam prae hodierna] The question whether the ancient or the modern music was most perfect was surely common at the time. Vossius in the preface (1673, fol. A4r–v) even states that the main aim of his work is that the musicians of today may be more modestly disposed towards their own music, and more benevolent towards the music of the ancients (*Satis mihi erit is hoc unum obtinero, ut de veterum cantu benignius, de suo vero modestius sentiant hodierni musici*). While Vossius thus thought more highly of the ancient, Kircher, for instance, ‘without discussion’ regarded the modern music to be ‘much more noble and perfect than the ancient, and endowed with a greater variety’ (Kircher 1650, vol. 1, pp. 545, 549 and 569).

When the same question is brought up for discussion in Bellman / Vallerius (1706, pp. 88 ff.) it is above all stressed that it is much more

difficult to hear the words of the songs of their own time. Likewise rhythm is too often recklessly treated. As a conclusion it is later stated that (p. 101) ‘if the music of our time shall raise to the peaks of the ancient, it is above all the duty of the poets, and then of the singers, to oppose those of its mistakes that have prevailed, and this shall happen, if the rhythm and times of the songs, as well as all each and every other thing, are all adequately observed:

Si ad fastigium antiquae Musicae adscendat hodierna, primo Poëtarum erit ac dein Cantorum, ejus erroribus, qui invaluerunt, occurrere, quod fiet, si carminum rhythmus et tempora reliquaque omnia et singula probe observentur.

11. **Mersennus, lib. 7, de cantibus, pag. 153]** As indicated above, book seven of Mersenne’s *Harmonicorum libri XII* (1648) has the title *De cantibus, seu cantilenis, earumque numero, partibus et speciebus*. In the section labelled as no. III on p. 153 we find the information that Retzelius refers to.

ex Mersenno ... Bannii sententiam lib. 7 explicante] The reference is to the same page, and even to the same section, as the abovementioned. There Mersenne relates Ban’s views that the measure of unequal time is either triple, sesquialter or hemiola.

Hemiolam] Literally, the *hemiola*, from the Greek ἡμιόλιος, means ‘the whole and a half’, just like the Latin *sesquialter*. Basically, it thus denotes the ratio 3:2. However, the meaning of the concept has differed in music history (see *GMO*; *MGG*, vol. 7, cols. 343 f.; Walther; Praetorius 1619, vol. III, pp. 53 f.; and Kircher 1650, vol. 1, pp. 681 f.). As explained by Mersenne, in his account of the views of Ban, the *hemiolia proportio* has the value of the half of the sesquialter proportion. While the latter is indicated with $\frac{3}{2}$ at the beginning of the staff, the hemiola proportion is indicated with $\frac{4}{4}$, and accordingly doubles the velocity of the sequialter proportion. In the hemiola proportion three crotchets complete one measure of time. This is later in this thesis expressed as ‘three quarters of one complete *tactus*’ (*tres quartas unius integri partes*).

12. **recipere ille tenetur]** The construction of *teneor* with an infinitive, in the sense of ‘must, have to’, is late Latin (Forcellini, s.v. *teneo*, 26; Blaise [1], s.v. *teneo*, 9). Accordingly it is rejected in both Noltenius (cols. 1780 f.) and Krebs & Schmalz (s.v. *tenere*).

abs re] The phrase is typical of neo-Latin, although not ‘Classically correct’, even according to authorities of the time (cf. Östlund 2000, p. 50; and Noltenius, col. 1242)

Poloness] At the end of the 17th century, the popularity of the polonaise, having its origins in Polish folk music, increased steadily in European

court culture, by mediation of the Polish nobility. The dance was characterized by a certain rhythmic pattern in triple time, which Retzelius in this passage is in fact one of the earliest authors to treat theoretically (*GMO*, s.v. *polonaise*. See further *MGG*, vol. 7, cols. 1686 ff.).

Proportion] The word at this time refers to the *proportz*, or *Nachtanz*, i.e. a kind of after-dance that comes about by the usage of a *proportio sesquialtera* on a melody in duple time. Three notes then take place in the time of the original two (*GMO*, s.v. *Proportz*, and *Nachtanz*).

qua notulas] As a preposition with the accusative, *qua* here means ‘as regards’, and this usage cannot be attested in ancient Latin at all. In neo-Latin texts, however, and especially in scholarly prose, it occurs frequently (see further Östlund 2000, p. 63; Örneholm 2003, pp. 132 ff.; and Eskhult 2007, pp. 228 f., where several examples from Swedish authors of the time are listed).

13. **admittere ... dignum]** An adjective of this kind with an infinitive is in ancient Latin mainly found in poetry and in later prose authors (K.-St., vol. 1, pp. 683 ff.).

temporis varietatem indicaturi Musici] As regards the development of the signs for duple and triple meter, as presented by Retzelius here, from the old mensuration signs, see Houle 1987, pp. 13 ff. and 57 ff.

Bannius ... apud Mersennum, pag. 153] Just as Retzelius says, the same signs are also reproduced in Mersenne’s account of Ban’s ideas in *Harmonicorum libri XII*. There the semicircle without the small rod going straight through it is explained as designating a slow measure, the one with a rod, however, as a measure which is twice as swift, and all other signs are rejected (1648, p. 153):

Semicirculus sine transversa virgula, systemati, seu scalae quinque linearum inscriptus hoc modo lentam semper mensuram designat, qui si virgula transversa secetur, duplo propemodum velocior mensura exigitur, poscente nimirum verborum contextu, ut impetu quodam feratur oratio Musica. Alia signa, inquit, a nostra Musica exsunt.

Grave, Largo] At the beginning of the 17th century, the term *grave* was still without a certain musical meaning, but at the end of the same century it is essentially used as an equivalent term to *adagio* for slow movements (*GMO*). In Walther it is thus explained as *ernsthafft, und folglich: langsam*.

The *largo*, however, had already such a musical meaning for a slower movement at the beginning of the 17th century. While Praetorius had seen *adagio* and *largo* as equivalents (*GMO*), Walther a century later explained it as *sehr langsam, den Tact gleichsam erweiternd, und grosse Tact-Zeiten*

oder Noten offft ungleich bemerckend (see further *MGG*, vol. 9, cols. 447 ff.).

Notably, neither *largo* nor *grave* are mentioned in the list of musical terms in Orostander's primer from the same time, but *allegro*, *adagio* and *lente* are. For the sake of ease, one could suppose, the sign of *adagio* and *lente* is there said to be **C**, while the sign of *allegro* is **♩** (see Lundberg & Sjökvist 2010, p. 86).

14. numerus ille fractus ... respicere ... manifestum est] As a technical term for fractional numbers in mathematics, *fractus* is first attested in medieval Latin, in translations from the Arabic (*DMLBS*, s.v. *frangere*, 6, d; cf. Solvang, s.v. *brøk*). In Micraelius (1661, col. 525) *fractio* is later explained as something that 'signifies the parts of the integer' (*fractus numerus partes rei integrae significans*), and the definition apparently echoes in Retzelius's text.

The sentence is anacoluthic (on anacoluthias in ancient Latin, occurring also in Cicero and Caesar, see Sz. pp. 730 f.). A *numerus illum fractum* instead of *numerus ille fractus* would, for instance, have brought about a correct accusative with infinitive in our case.

fatebamur] The use of the imperfect tense in clauses like this one, when the writer refers to his earlier words, seemingly addressing the reader's memory, is mainly pre-Classical and late Latin (K.-St., I, p. 124).

ad singulos Tactus constituendum] The construction with *ad*+gerund with an object, here instead of *ad singulos Tactus constituendos*, is rare in Classical Latin, but becomes more common in late Latin (K.-St., I, p. 735; and Aalto 1949, pp. 89 f., see also the commentary on thesis 5 above).

quod ... videamus] Causal *quod*-clauses often have the subjunctive in neo-Latin texts quite generally. The usage is not Classical, but mainly late Latin (cf. e.g. Tengström 1983, pp. 74 f.).

16. prensatum ire] As regards this active future infinitive form, obviously modelled on such rather rare examples from ancient Latin as *ultum ire* and *ereptum ire*, which can be found in Classical Latin, but becomes more common in late Latin, see Sz., pp. 312 f. and 381.

levi, quod ajunt, brachio] The phrase *leve brachium* (literally 'light arm') is proverbial, regarding when things are carried out slackly. This is also indicated by the *quod ajunt* (Otto, p. 58; *OLD*, s.v. *brachium*, 2, d).

Kircherus, lib. 7, de Musurgia Antiquo-Moderna] The heading of book seven of Kircher's *Musurgia universalis* (1650) is *De Musurgia Antiquo-moderna, in qua de varia utriusque Musicae ratione disputatur* ('on ancient-modern *musurgia*, in which the vaying methods of both these kinds of music are discussed'). The quotation is taken literally from the very beginning of chapter ten, in which he deals with musical time in vol. 1 on p. 676. Moreover, Isaac Vossius in his *De poematum cantu et*

viribus rythmi (1673), p. 72, expresses the same view, that previous musical authors have written too little and too confusedly on *tactus*, thereby neglecting that which is most important of all in music.

Franchino] Franchino Gafori (1451–1522), Italian music theorist and musician. His most important works are the *Theorica musicae* (1492), *Practica musice* (1496) and *De harmonia musicorum instrumentorum opus* (1518).

Zarlino] Gioseffo Zarlino (1517–1590), Italian music theorist and composer. His most important work, which primarily treats counterpoint, is *Le istitutioni harmoniche* (1588).

Glareano] Heinrich Glarean (1488–1563), Swiss music theorist and geographer. With his *Dodecachordon* (1547) he introduced the very influential system of twelve modes.

17. **Musica ... Pathetica]** The *musica pathetica* at the time almost serves as a technical term for music as stirring the affects of man. As Kircher states (1650, vol. 1, p. 564), ‘its only end is to move different affects according to the principle of a proposed and adopted theme’ (*Cum patheticae musicae unicus finis sit, affectus varios iuxta propositi assumptique thematis rationem movere*). This is seen also in his definition of the concept (vol. 1, p. 578: ‘harmonious music making, or composition arranged with such art and intellect by a learned man, that excites the listener to any given affect of the mind’ (*harmonica melothesia, sive compositio ea arte et ingenio a perito instituta, ut ad datum quemcumque animi affectum auditorem concitet*). For an overview of theories dealing with the subject, see Palisca 2006, pp. 179 ff. For one focusing on rhythm and the affects in Vallerius’s time, see Houle 1987, pp. 71 ff.

Vossius, qui de Poematum cantu et viribus Rhythmi] The reference again is to Vossius, *De Poematum cantu et viribus rhythmi* (1673), to a passage where the author stresses the importance given to rhythm and metre among the ancient authors and musicians, in contrast primarily to that given to it by contemporary authors in vernacular languages. The literal quotation that follows can be found on p. 43, just as Retzelius says.

e Dionysio Halicarnassensi ... adducit] Directly following the quoted passage, Retzelius paraphrases, and partly quotes, Vossius’s discussion, where Dionysius of Halicarnassus (the Greek historian and teacher of rhetoric living in the 1st century BC) and his *praeclarus de collocatione verborum libellus* is referred to, i.e. the *Περὶ συνθέσεως ὀνομάτων* (‘On the arrangement of words’). In section 15 of that work there is a discussion on the different length of short syllables with precisely the Greek words here as examples. When Vossius has mentioned the four Greek words, he continues with a passage that Retzelius paraphrases (1673, p. 43):

... in quibus licet breves dicantur priores quaelibet syllabae, satis tamen sensile est temporis discrimen, quod in singulis, ut distincte proferantur, requiritur.

Hanc, inquam, syllabarum ... ρυθμὸς] Retzelius here refers to some of Vossius's later words, in which it is stated that all the power of music lies in rhythm, but also that the ancient rhetoricians therefore were eager to transfer musical rhythm into their own discipline as well (1673, p. 60):

Cum itaque tota musicae potestas in rythmo seu numero consistat, siquidem τὸ πᾶν παρὰ μουσικοῖς ὁ ρυθμὸς, ut loquuntur veteres, ecquis miretur antiquos illos dicendi magistros sollicitos fuisse in transferendis ad suam artem modis musicis, et tradendis adeo copiose omnibus istis praeceptis quae ad numerum oratorium maxime pertinere viderentur?

For a thorough discussion of the great importance of rhythm among the Greeks, see West 1992, pp. 129 f. As regards the representativity of this importance of rhythm in music in the theoretical discourse of the time of Vallerius, see e.g. Gouk 1999, pp. 212 f.

According to Retzelius, the Greek sentence τὸ πᾶν παρὰ μουσικοῖς ὁ ρυθμὸς had become proverbial, but this cannot be attested. It could perhaps only be a misunderstanding of Vossius's words *ut loquuntur veteres*, which could equally much only be regarded as a kind of summarizing statement on passages dealing with rhythm among the ancient authors.

Unde etiam ... Musicis damnet] Retzelius in this sentence paraphrases the following quotation, which has been taken literally from p. 59 in Vossius's work, in a context where the Dutch author questions the probability of the widely spread story on how a Danish king was driven to fury and insanity by the songs of a citharist. Such a citharist cannot be found in our time, Vossius claims. Moreover, Retzelius also summarizes Vossius's very long discussion on the weaknesses of modern music, which is concluded on the very last page, where Vossius says that metrical and rhythmical method would revive the wonderful effects of the ancient music (1673, p. 136):

... ut dubium non sit, quin si cadaveroso pene seculi hujus cantui metrica et rhythmica accedat ratio, simul quoque reviviscant mirandi antiquae musicae effectus.

18. **Kircherus, pag. 550]** In Kircher's (1650, vol. 1, p. 550) account of different ways in which music can affect human beings, he mentions the *modus naturalis* as the third, and this he divides into the four aspects related by Retzelius here: *harmonia, numerus seu proportio, oratio et subjectum capax*. The same four prerequisites for music for stirring the affects are later also stressed in Bellman / Vallerius (1706, pp. 80 ff.), but in other

words and in a different order: *Numerosus Rhythmus, Harmonia, Verba cantus*, and *subjectum capax*.

experimentum ... Kircherus ostendit] The experiment mentioned, in which Kircher shows how different sounds stir different liquids in glasses differently, can be found in book 9 of Kircher's *Musurgia* (1650, vol. 2, p. 212). But the experiment is also referred to by Kircher himself in book 7 (1650, vol. 1, p. 551), close to the quotation above.

sed etiam bruta, teste ipso Kirchero] Cf. thesis 69 of *De sono* above, and the commentary on that thesis.

id quod ex lyra ista rusticorum ... clarissime patet] As regards this section on the *Nyckelgiga* ('keyed fiddle'), cf. thesis 103 in the dissertation *De modis* above, where the custom of expressing the *tactus* with hands and feet is also especially associated with the playing of the keyed fiddle.

19. **In Tactu ... Musicae vis et efficacia consistit]** The entire thesis is, as Retzelius indicates at the end of it, close to a section in Vossius's abovementioned work on rhythm, even on a verbal level, in which the Dutch scholar states that the entire power of music lies in rhythm. A man who is ignorant of rhythm cannot be called a musician (1673, pp. 71 f.):

Nam certe cum tota musicae potestas in rythmo consistat, et absque eo omnis cantus sit inconditus, illud omnino demonstrandum erat, non in simplici sono sitam esse vim istam quae animos et affectus moveat, sed soli propemodum rythmo hanc inesse efficaciam, et verum esse quod jam superius monuimus, rythmum esse τὸ πᾶν παρὰ μουσικοῖς, nec posse musicum dici, qui rythmum ignoret.

The idea of rhythm as the soul of all music is also later repeated and stressed in the dissertations *De tarantula* (1702, p. 19), and *Disputatio philosophica parallelismum microcosmi et macrocosmi breviter delineans* (1711, p. 40), both defended under Vallerius's presidency.

Finge cantilenas multarum vocum absque Tactu ...] A similar discussion can be found in Dionysius of Halicarnassus, which we saw above that Vossius had read closely. See e.g. in *Demosthenes*, 48:

Consider: if in composing the most beautiful melody for vocal or instrumental performance one paid no attention to rhythm, could the resulting music possibly be endurable?¹⁵⁶

20. **tympana militaria (pukor et trummor)]** In Swedberg, both *puka* and *trumma* are translated as *tympanum* in Latin, so Retzelius obviously needed to explain the Latin concept with the more specific vernacular

¹⁵⁶ Translation by Stephen Usher in *Dionysius of Halicarnassus. The Critical Essays in Two Volumes* (Loeb), vol. I, p. 423.

designations. While *trummor* is ‘drums’ in English, we would more precisely render *pukor* as ‘kettledrums’, and both were used within the military.

De Castagnetis Mersennus, lib. 4, de Campanis] The fourth book in Marin Mersenne’s section on instruments in his *Harmonicorum libri XII* (1648, p. 145) has the title *De campanis, et aliis instrumentis ... percussionis, ut tympanis, Cymbalis, etc.* (‘on bells and other percussion instruments, such as drums, cymbals, etc.’). The first part of the quoted passage, which has been syntactically adjusted here, can be found in proposition 16 on p. 161. The second part is found on p. 162, and there Retzelius has omitted the words *vel alios oscillis* between *prementibus* and *editos*.

Citharae Hispanicae] This is what the Spanish guitar is rendered as in Latin (Mersenne 1648, p. [ii]9; Walther, s.v. *Chitarra*). The guitar had five strings at this time, and was according to Walther: *sonderlich vom Spanischen Frauenzimmer gebraucht*. We find it depicted and treated in proposition 21 of the first book of Mersenne’s treatment of instruments (1648, pp. [ii]27 ff.; see further *GMO*, s.v. *guitar*, 4; and *MGG*, vol. 3, cols. 1334 ff.).

verissimam Kircheri sententiam] Kircher twice stresses the great importance of the minor semitone in the *Musurgia* (1650, vol. 1, pp. 147 and 554); without it there would be no variation in music. In the latter of these Kircher stresses both the *tactus* and the semitone: ‘this power of the semitone, is much increased from the proportion of time and rhythm itself’ (*haec semitonij potestas plurimum augmentum ex temporis proportionem et ipso rhythmo nanciscitur*).

Gallicum Mersenni tractatum] The reference is still to the treatment of instruments in Mersenne’s Latin *Harmonicorum libri XII* (1648). Mersenne himself referred to his French treatment just before the quoted passage, and that explains also Retzelius’s words. On pp. [ii]164 f., Mersenne writes that the reader can find the information in his French book, how military drums give signal for the *veille*, march, etc. One should, however, be aware of the fact that the foot is considered to be the same, even when one note is replaced by 2, 4, 8 or 16 minor ones, since diminution does not change the foot:

... ex libro Gallico transferre possis, quo militaris tympani cantus ad inclinium, conuentum, gradum, etc. complexi sumus. Exempli gratia, gressus nostrorum militum hoc rythmo saepius repetito ... hoc est Pyrrichi-anapesto: gradus Helueticus Ionico minore ... ; aliorum gressus Iambico ..., vel Anapesto ... regitur.

Obserua tamen eundem censeri pedem, licet in unius temporis brevis locum 2, 4, 8, vel 16 minutiora tempora succedant, uti fit in compositionibus Musicis, hae siquidem diminutiones pedem non mutant.

As we can see, the quotation has only been slightly altered, the greatest difference being the staff with rythmical feet that as been inserted into the middle of it.

Tympanotribarum] The word is a hapax in ancient Latin literature, in Plaut. *Truc.* 611. Noltenius (col. 1201) thus accepts it, but prefers *tympana pulsare solitus*, which is attested in Curtius. Walther also translates it as *ein Paucker, ein Trummelschläger*.

MARCHE] The French word was used for a military signal to march, sounded on a drum at the time (*SAOB*, s.v. *marsch*, 3; *OED*, s.v. *march*, n⁵, II, 2, a).

Rewalie] The form, which is not attested among the many variants in *SAOB*, is obviously a Swedish rendering of the French *reveille*, which was a military signal for awakening the personnel (*SAOB*, s.v. *revelj*; *OED*, s.v. *reveille*, 1).

Aftropp] The Swedish noun refers to the military signal used for ordering the forces to troop off or disperse (*SAOB*, s.v. *aftropp*, a; cf. *OED*, s.v. *troop*, v, 3).

Förgalringen] The word is an older corrupted Swedish variant of *förgadring* (from Low German *vorgaderen*), which refers to the military signal for assembling the forces for marching off (*SAOB*, s.v. *förgadring*, 2; cf. *OED*, s.v. *troop*, n, 4).

CHORUM] The word, which is derived from the Latin *chorus* (in the sense of *choir*), is here used for the military signal for assembling the forces to prayers (cf. *SAOB*, s.v. *korum*).

21. **Thesis XXI]** There is a rather strong break here from the previous discussion, in comparison to the other passages from one thesis to another, but also a sarcastic tone that cannot be found earlier in Retzelius's writing. If we compare his entire dissertation to the others treated in this study, we see that they both had different kinds of *corollaria* attached after the actual dissertation, but here there is none. As it seems, this last thesis instead served as a kind of entertaining epilogue, in which Retzelius as the author took up an idea on the subject that he strongly disagreed with, and even found ridiculous. I shall point out some features indicating this in the following.

Lipstorp ... speciminibus Philosophiae Cartesii, part. 3, pag. 206] The German astronomer and mathematician Daniel Lipstorp (1631–1684) was among other things court mathematician at Weimar, professor of law at Uppsala university between 1662 and 1674, and thereafter *advocatus curiae* in Haag (*ADB*, s.v. *Lipstorp, Daniel, L.*). He published his *Specimina philosophiae Cartesianae* in Leiden 1653. On pp. 205 f. of this work, which falls in a passage on the measuring of time which covers pages 200–207, there is a section that Retzelius relates to very closely, in differ-

ent ways (the section printed in italics in Retzelius's text is underlined below):

Non dicam nunc de incomparabili Astronorum sui aevi Phoenice Tychone Brahaeo, qui temporum dimensionem studens sub initium suae Restitutionis, aqua, arena, plumbo calcinato, argento vivo pluries exstillato usus est, et adhuc quaerens fluxus aequalitatem fatis functus est, antequam horas distinguere praecise nosset.

Concludimus ergo, esse modum dimetiendi temporum intervalla a Lobkowitzio excogitatum non vulgarem, neque ob id sine praegnantia causa repudiandum, utpote qui omnibus aliis mensuris certudinis palmam praeripiat, in explorandis brevium motuum terminis. Cui non incommode adjungimus alium modum ad brevissimorum motuum intervalla determinanda idoneum; *Tactum* nempe *Musicum*, uti vulgo appellant illud musicorum moderamen, quo jucundissimos concentus musicos componunt, et feliciter dirigunt; Cui bono eligendi essent tenues quidam, albicantes, et politici scipiones, diversis eos uno eodemque tempore ad eosdem usus usurpantibus, ut tanto major sit observationum harmonia, tantoque melius discrimina evitentur: Etenim quod ab uno forsitan peccaretur, alius resarciret et emendaret.

The section from *Cui non incommode adjungimus* until the end of this quotation is all that Lipstorp says about musical *tactus* in connection to time measuring. As we shall see, Retzelius at the end rejects the idea of using *tactus* as a means of distinguishing short time and short motions as ridiculous, and only worthy of laughter. Perhaps Lipstorp with *tactus musicus* in the passage rather referred to a metronome, but this was obviously not how Retzelius understood it.

Cum tamen ... Tychonem Brahaeum] The reference is to the well-known Danish astronomer Tycho Brahe (1546–1601), and his attempts to invent instruments for measuring time. The mention that Brahe had died when studying time and its measuring is only made for humorous effect, we can assume, as if Retzelius was now going to venture upon something extremely dangerous.

Phoenicem] The expression is proverbial for an outstanding and excellent person (*OED*, s.v. *phoenix*, 2, a), the phoenix being that unique mythological Arab bird that was born very rarely, lived for a very long time, and was born again from itself (see e.g. Henkel & Schöne, cols. 794 ff., for the theme as represented in emblems from the early modern period, cf. Otto, p. 278). The thought is consequently that Tycho Brahe represents the resurrection of the glorious astronomy of the ancients.

plumbo calcinato] The multiword term refers to litharge of lead, a protoxide 'prepared by exposing melted lead to a current of air' (*OED*, s.v. *litharge*; Hooper 1801, s.v. *oxydum plumbi semivitreum*).

argento vivo] i.e. mercury, or quicksilver (*DMLBS*, s.v. *argentum*, 5). Its alternative Latin name *hydrargyrum* explains its chemical designation Hg (*OED*, s.v. *hydrargyrum*; Hooper 1801, s.v. *hydrargyrus*).

a modo illo Lobkovitzii] The reference is to the Spanish ecclesiastic, scholar and music theorist Juan Caramuel y Lobkowitz (1606–1682, on whom see e.g. *ADB*, s.v. *Caramuel y Lobkowitz, Joh.*), whose method of measuring time Daniel Lipstorp accounts for in the abovementioned book (1653, pp. 201 ff.). Lipstorp has in his turn, as he says himself, read about Caramuel y Lobkowitz's method in the Spanish scholar's *Perpendicularum inconstantia* ... (Leuven 1643).

extra sphaeram suam Tactus Musicus vagari] If pendulums are rejected for time measuring by some scholars because of the variety of the air, the human arms should perhaps not be reliable, since they can become tired and weak, Retzelius contends, and with ironic distance demonstrates how strange the idea is.

cum funependula ... se probare non potuerint] Retzelius refers to Lipstorp's summarizing account of Lobkowitz's discussion in *Perpendicularum inconstantia*, as related in Lipstorp 1653, pp. 201 ff.

Chronometron] The word is a neo-Latin neologism for an instrument that measures time (*SAOB*, s.v. *kronometer*; *OED*, s.v. *chronometer*). In Kircher, however, it is equivalent to *tactus* (1650, vol. 2, p. 52): *Itali vocant la battuta, Boetius plausum, alij tactum et mensuram, nos Chronometron intitulumus*. Cf. Walther, where it is explained as *das Zeit-Maass, i.e. der Tact, weil durch selbigen die Zeit abgemessen wird*. The same word can also be used more narrowly about the metronome (*SAOB*, s.v. *kronometer*, 2; *OED*, s.v. *chronometer*, 2).

non vulgarem] Notice the ironic allusion made to Lipstorp's own words on Lobkowitz's method in the quotation above.

Gratulatio I

1–6] The first lines of course refer to the Pythagorean doctrine of the harmony of the spheres, to which Plato also adhered. The stars there move very rapidly in real spheres, and emit a harmonious sound that humans cannot hear, music in itself being a reflection of a universal harmony governed by numbers. Johannes Vallerius himself considers the idea to be nonsense, but in fact there were still people who believed in it at the end of the 17th century, and the titles of Kepler's *Harmonices mundi* (1619), Mersenne's *Harmonie universelle* (1636–1637), and Kircher's *Musurgia universalis* (1650) all testify to the continuous importance of the idea in music philosophy at the time (cf. Gouk 2002, pp. 227 f.). Universal harmony is also the subject of the entire book 10 of Kircher's *Musurgia* (among the vast amount of literature written on the subject, see e.g. Palisca 1985, pp. 161 ff.; Palisca 2006, pp. 13 ff., and *GMO*, s.v. *music of the spheres*, with further references).

4. **septem gyros**] i.e. the seven stars of antiquity, the *septem errantia*, i.e. Saturn, Jupiter, Mars, the Sun, Venus, Mercury, and the Moon. These are explained and described in for example the *Somnium Scipionis* (Cic. *rep.* 6.17), one of the most important and influential ancient texts treating the harmony of the spheres.
7. **tremulo demulces aëra tactu**] Cf. Ov. *fast.* 1.151: *volucres concentibus aera mulcent*.
- 7–14.] The second part of the poem, beginning with the anaphorical *O quoties*, refers to Retzelius both as a music theorist, which he has demonstrated himself to be with the present dissertation, and as a practical musician. As we saw in the biographical notes at the beginning of this commentary, Retzelius and Johannes Vallerius were both among the eight holders of musical scholarships at the university, and therefore fellow musicians in its *chorus musicus* (cf. Kuhlberg 1977, p. 7).
- 9–12.] The passage contains several reminiscences from and verbal correspondences with Vergil's first eclogue, lines 1–5, some of which are underlined in the text below:

Tityre, tu patulae recubans sub tegmine fagi
 silvestrem tenui musam meditaris avena:
 nos patriae fines et dulcia linquimus arva.
 Vos patriam fugimus: tu, Tityre, lentus in umbra
 formonsam resonare doces Amaryllida silvas.

Johannes Vallerius has clearly had this section in mind, and with it all associations connected to it, including the importance of music in the pastoral setting. For Vergil's first eclogue holds a unique position in our literary history. The study of Latin poetry in Swedish schools for a long time began with this eclogue, and the same was often the case in other parts of Europe (see further Sjökvist 2007, p. 47). One can therefore assume that everyone with knowledge of Latin was familiar with it. Likewise most people knew that Tityrus was generally considered to be Vergil himself in allegorical disguise (see Sjökvist 2007, p. 45). The allusion thus also contains the idea that Retzelius resembles Vergil, if only in a more general sense as a proficient servant of the Muses in his field, rather than as a sharer of the Roman poet's harsh fate.

- 9–11. **Euterpe ... Terpsichore**] Both are mentioned as Muses already in Hesiodos (*theog.* 77 ff.), but their attributes and fields of activity were not fully settled until late antiquity (Roscher, vol. II:2, cols. 3293 ff.). In Hor. *carm.* 1.1.32 f. Euterpe is responsible for flute playing, which we saw in the second gratulatory address in *De sono* above, and this was also generally to become her attribute. In Melchior Weinrich's *Aerarium poeticum* (1677, p. 90) she is e.g. described as *Calamis instructa canoris. Dulciloquis calamos quae flatibus urget. Cujus plus aliis fistula canit*, etc.

Terpsichore, however, is there depicted as the Muse of lute playing and dancing, as (1677, p. 91): *Choreis gaudens. Quae movet affectum cithara mollique chorea*, etc. (we here find echoes of both from the 3rd century *Versus de Musis* that allegedly had been written by Marcus Porcius Cato: *Dulciloquis calamos Euterpe flatibus urguet* [v. 2], and *Terpsichore affectus citharis mouet impetrat auget* [v. 5]).

10. **Pana]** i.e. certainly Pan, the god of the woods and the shepherds. The accusative form is Greek.
11. **carmina plectro]** The hexameter-ending also occurs in Prop. 2.3a.20, in a context where the lute playing of the Muses is referred to: *et quantum Aeolio cum temptat carmina plectro, par Aganippaeae ludere docta lyrae*.
- 13–14. **MUSIS, MUSARUM MUSICA fecit, / Ut vel MUSARUM]** The last lines make up the climax of the poem. With the rhetorical device generally called *polyptoton*, i.e. the same word repeated in different case-forms (e.g. Lausberg 1973, pp. 312 ff.), which is also printed in capitals, the stress here becomes considerable.

Moreover, the message must be understood as twofold. The Muses often represent academic learning at this time, as we saw above. But in this poem, the Muses mentioned both represent music in particular. And this holds true also for Retzelius. Johannes Vallerius thus exhorts him to devote himself to the Muses both practically and theoretically at the university.

pridie iduum Novembris] i.e. 12 November.

Johannes Vallerius] Harald's son Johannes was born in Uppsala in 1677. He matriculated at the university as early as 16 June 1683 (*Uppsala Universitets matrikel*, vol. 1, p. 284), and was awarded with a musical scholarship in 1696 together with Retzelius, among others (*Akademiska konsistoriets protokoll*, XXI, p. 349). He won the master's degree in 1700, with a dissertation entitled *De aurora* ('on sunrise'), and succeeded his father to the chair of mathematics in 1712. 31 dissertations were defended under his presidency, in subjects as philosophy, topography, and mathematics (Lidén 1778, pp. 499 and 505). He died in 1718 (Odén 1902, p. 88).

Gratulatio 2

1. **Pellaeo ... Tyranno]** The combination also occurs in Mart. 9.43.7. The reference is to Alexander the Great, *Pellaeus* referring to the royal residence of Pella in Macedonia (see further Henriksén 1998, p. 209). Alexander's promotion of music can be seen for example at his wedding festivities, where a considerable number of musicians are said to have performed, among them harpists and *aulos* players. Later on he also, for instance, arranged musical and athletic contests at Ecbatana with thousands of competitors, as related by Plutarch (West 1992, p. 373).

3–8.] The lines are most closely related to Sil. 11.440 ff., the beginning of the passage in which Teuthras the musician plays and sings for Hannibal during a luxurious banquet in Capua, about the wonderful things that the power of music had accomplished in history. In the catalogue – such short catalogues of important mythological musicians appear in several Classical Latin poets, as we shall see below (in an account that by no means pretends to be exhaustive) – we meet Amphion, Arion, Chiron, and Orpheus, three of which Hallenberg also accounts for in his poem. Amphion built the walls around Thebe by playing on his lyre; Chiron the centaur educated Achilles by lyre playing, the force of which could even calm stormy seas and the wrath of the underworld; Orpheus charmed all gods and goddesses with his lyre, and this even earned it a place among the stars:

Argolicis quondam populis, mirabile dictu,
exaudita chelys, lapidem testudine felix
ducere et in muris posuisse volentia saxa.
haec Amphiono vallavit pectine Thebas
ac, silice aggeribus per se scandente vocatis,
iussit in immensum cantatas surgere turres.
altera, turbatam plectro moderata profundum,
et tenuit phocas et in omni Protea forma
traxit et aequoreo portavit Ariona dorso.
iam, quae Peliaca formabat rupe canendo
heroum mentes et magni pectora Achillis,
Centauro dilecta chelys, compesceret iras,
percussa fide, vel pelagi vel tristis Avernī.
sed, quos pulsabat Rhiphaeum ad Strymona, nervi,
auditus superis, auditus manibus Orpheus,
emerito fulgent clara inter sidera caelo ...

3. **Chiron**] Chiron is the civilized centaur that lived in a cave on Mount Pelion in Thessaly, and there taught several heroes the art of lyre playing, among other things, viz. Achilles (e.g. in Hom. *Il.* 11.831 f.), and Jason and Asclepius, to name but two (Roscher, vol. I:1, cols. 888 ff.).
5. **Amphion**] Amphion had received his lyre from Hermes himself, and by playing this he and his brother Zethos had allegedly built the walls around Thebe. While Zethos used his physical strength, Amphion moved the stones exclusively with the music of his lyre (Roscher, vol. I:1, cols. 312 ff.). Horace, for instance, likewise referred to the power of music displayed by Amphion (and Orpheus) in his *Ars poetica* (391 ff.):

Silvestris homines sacer interpretsque deorum
caedibus et victu foedo deterruit Orpheus,
dictus ob hoc lenire tigris rabidosque leones.
dictus et Amphion, Thebaeae conditor urbis,
saxa movere sono testudinis ...

7. **Auritas ... silvas]** The combination (*auritus* = with ears) probably alludes to Hor. *carm.* 1.12.10 ff., where Orpheus is said to have checked the courses of rivers, and made the oaks listen to him:

arte materna rapidos morantem [Orphea]
fluminum lapsus celeresque ventos,
blandum et auritas fidibus canoris
ducere quercus.

- Rhodopejus heros]** i.e. Orpheus, with whose musical skill we are all familiar, not least by mediation of Ovid's version of Orpheus and Eurydike in the tenth book of the *Metamorphoses*. As regards the attribute *Rhodopejus*, cf. e.g. Ov. *ars* 3.321 ff., where we first meet Orpheus, then Amphion building the walls, and then Arion, who even made fish obey him:

saxa ferasque lyra movit Rhodopeius Orpheus,
Tartareosque lacus tergeminiūque canem.
Saxa tuo cantu, vindex iustissime matris,
Fecerunt muros officiosa novos.
Quamvis mutus erat, voci favisse putatur
Piscis, Arioniae fabula nota lyrae.

Orpheus is in antiquity generally held to be from Thrace (see further Roscher, vol. III:1, cols. 1078 ff.), the region which Mount Rhodope occasionally stands for metonymically. *Rhodopejus* is thus the same as Thracian.

8. **feras detinuisse lyra]** Cf. Prop. 3.2.3 ff. (in which *detinuisse* is a variant reading), where Orpheus is said to have checked both beasts and rivers with his lyre; the walls of Thebe to have built themselves stirred by the art; Galatea to have tamed her horses with music:

Orphea detinuisse feras et concita dicunt
flumina Threicia sustinuisse lyra;
saxa Cithaeronis Thebas agitata per artem
sponte sua in muri membra coisse ferunt;
quin etiam, Polypheme, fere Galatea sub Aetna
ad tua rorantes carmina flexit equos.

9. **murmura Tactu]** The hexameter-ending also occurs also in Claud. 17.316: *magna levi detrudens murmura tactu*, in a context where music forces away the great buzz of the crowd. In Hallenberg's case, the buzz is rather made into music by means of the *tactus*.
10. **pectora nostra moves]** The poetical building block also occurs in Val. Fl. 4.219: (*nec lacrimae – ne ferte preces – superive vocati*) *pectora nostra movent*.

11. **victurae commendant nomina chartae]** Cf. e.g. Mart. 1.25.7: *post te victurae per te quoque vivere chartae*, and 7.44.7: *si victura meis mandantur nomina chartis*. Both verses refer to a long-lasting and posthumous reputation thanks to written texts.

S. HALLENBERG] Sveno Petri Hallenberg was born in 1672 in Hal-lingeberg in Östergötland as the son of a tailor and bailiff of the farms of a landlord (*landbofogde*). He matriculated at Uppsala University on 6 February 1690 (*Uppsala Universitets matrikel*, vol. 1, p. 329), but it seems he never defended any dissertation. He later made a career as a jurist, and ended his days as a chief judge (*lagman*) in a district court in Skåne. He was ennobled in 1720, under the name Hallenborg, and died in 1736 (Odén 1902, p. 100; and Elgenstierna 1998, vol. III, p. 423).

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6 Index

In this index are primarily listed names and Latin and vernacular words that are discussed in the introduction chapter or in the commentaries, grammatical and stylistic features, as well as *termini technici* from music theory and the history of sciences and ideas. Names mentioned only in references are not indicated in the index, with some exceptions. Broader subjects treated in the dissertations are accounted for in the structure and contents sections that precede the commentaries.

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