

Journey to the Heart of Music

Philip Perry

Copyright P.J. Perry © 2003, 2006, 2009. This document may only be reproduced and used for non-commercial purposes. Any reproduction must include this copyright notice and the document may not be changed in any way. The right of Philip J. Perry to be identified as the author of this work has been asserted by him in accordance with the UK Copyright, Designs and Patents Act, 1988.

Chapter 8 – The Tonal Era

A SHORT HISTORY OF MUSIC AND MUSIC THEORY

The story of the historical development of western music represents a broad and deep expanse of scholarship which has filled many books and will, no doubt, fill many more. This chapter is intended to serve as a brief survey of the principal stylistic trends in western music from medieval times up to the present day, focusing in particular, on elements relevant to the argument that the harmonic core of western musical art functions, effectively, as a number system. Thus, presented below is a partial reading, involving considerable oversimplification, tracing out the forward sweep of harmonic developments – written with an eye to integrating some of the landmarks of music theory, rather than attempting a full and balanced historic narrative.

Indeed the story outlined below revolves, more than anything else, around the repeated difficulties encountered by music theorists in adequately explaining the origin and nature of the minor triad. As in the case of an alibi, it only requires one inconsistency for the police to know that they have yet to reached the whole truth; similarly, music theory has struggled to come up with a complete and consistent understanding of harmony that satisfactorily includes the minor chord. That the major chord emerges naturally from the harmonic series is generally accepted, as is the identification of its root note with the fundamental of the series. However, this is not the case for the minor chord and its root. When the minor triad is placed within the context of a harmonic series, its root, clearly perceived, is different from the fundamental of the series. Yet paradoxically, the first-difference combination tone agrees with the fundamental of the series and not the perceived root note! The role and nature of the minor chord has been a long-running problem in music theory dating back, at least, to Gioseffo Zarlino writing in 1558. Highlighted below, in particular, are the landmark advances made by theorists on this continuing conundrum.

In a manner rather like viewing an impressionist painting, coming too close to the canvas can actually inhibit an observer's ability to apprehend the overall theme. Similarly, some trends in western music best reveal themselves when viewed at the large scale and from a high-level perspective. Though the styles – the external clothes of form and idiom – changed markedly from period to period, from masses and motets to concertos and symphonies, from unaccompanied voices to mighty orchestras, an underlying unity pervades the music of western Europe from the sixteenth to the nineteenth century. Indeed this epoch could be referred to as the *period of common harmonic practice* – to extend a little the focus of a frequently used phrase. And so it is to the broad sweep of this inner commonality of tonal harmony – the lingua franca of mutable numbers expressed in sound – that we turn our attention.

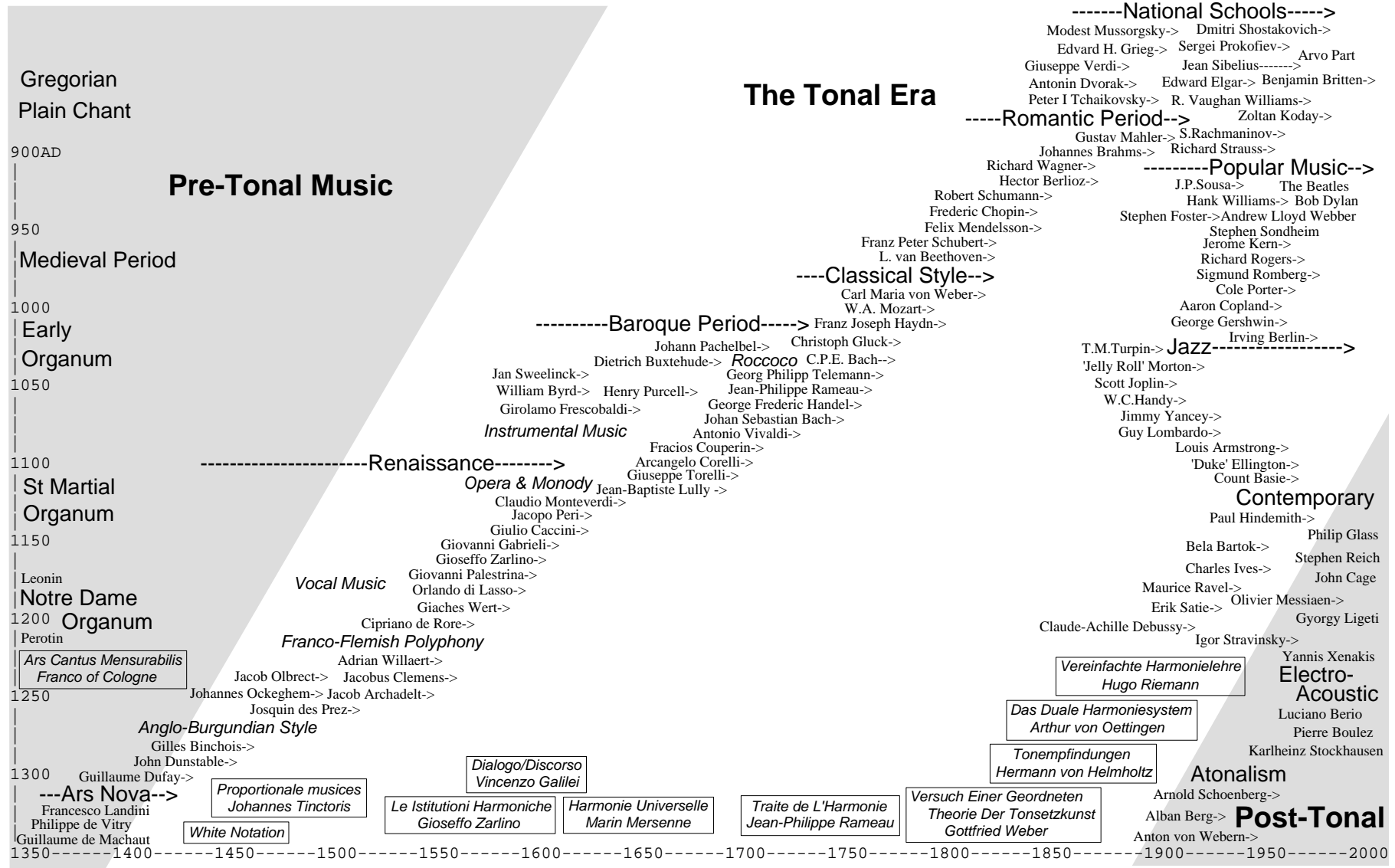
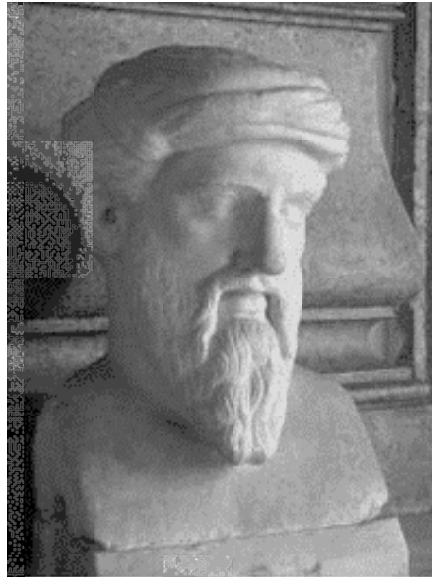


Figure 8.1

8.3 – A SHORT HISTORY OF MUSIC AND MUSIC THEORY

To aid this high level approach Figure 8.1 provides an overview of the stylistic development of western music: A time line beginning in the medieval epoch traces the centuries from 900 AD at the top left-hand corner of Figure 8.1, down the left-hand margin and then across the bottom of the chart. Gray shaded areas mark the *Pre-Tonal* period to the left and the *Post-Tonal* period to the bottom right of the figure. Between these two ‘bookends’ lies the broad white slash of the *Tonal Era*. Unlike the pre-tonal section, the gray post-tonal section does not fill the whole right-hand margin: allowing the white tonal era slash to continue on passed 2000AD. This sharing of the right margin acknowledges the continuing, and indeed somewhat refreshed, tonal music traditions of the present day.

The Ancient Background



Picture courtesy Wikipedia

Pythagoras of Samos, circa 575–495 BC, was born on the Aegean island of Samos (close to the coast of present-day Turkey) to prosperous parents. Pythagoras used his inheritance to travel widely and learn of the accumulated knowledge of other civilizations, the Babylonians and Egyptians, as well as visiting Thales of Miletus the father of Greek science or natural philosophy. Over many years of travel and adventure he acquired a broad base of learning, which he distilled into a credo, part philosophical part religious, centered on the concept that *mathematics represents the ultimate level of reality* and that all phenomena in the world can be understood in terms of number. This idea has remained a central guiding insight of natural philosophy and science down to the present day. Traditionally, Pythagoras’ discovery of the link between music and numbers, the ratios of musically pleasing intervals of pitch, is credited to the ringing sounds emanating from a blacksmith’s workshop as the workmen employed different-sized hammers and anvils – Pythagoras realised that the relative size and weights bore a proportional relationship to the ringing tone they produced. In later life Pythagoras established a brotherhood of like-minded ‘philosophers’ at Croton, a Greek settlement in southern Italy. After a peaceful start, the secretive brotherhood of Pythagoreans became embroiled in local political arguments and their community was attacked. The precise time and place of Pythagoras’ death is unknown, but, the Pythagorean brotherhood continued in various forms for centuries afterwards, and Pythagoras’ influence has remained an enduring and fruitful legacy in western philosophy and science.

Effectively there is a discontinuity between ancient musical practice and music in the modern period, i.e. western music from circa 500 AD. The living tradition of ancient musicmaking was more or less completely extinguished in the west during the long eclipse of the dark ages. Other traditions of more primitive music came with the invading armies and settlers, and established traditions were lost or withered in the disruption. Later, as the Church established a leading cultural position, it preferred to expunge

8.4 – A SHORT HISTORY OF MUSIC AND MUSIC THEORY

memories of ancient pagan practices, or at least, remould them to suit the Christian ethic.

Little is really known of what ancient western music – that is for the most part ancient Greek music – actually sounded like. Perhaps some inkling of the flavor of this lost tradition can be found in living monophonic music cultures such as that of India, but the precise character of its soundscapes are probably gone forever. However, what is reasonably clear is that it was melodic/monophonic, perhaps heterophonic at times, but not polyphonic as in the modern period, and, with a close nexus between words and melodies, probably employed expressive microtonal inflections of its scale(s). As with almost all things Greek, it spawned a complex theory, and it is hard today to credit the importance that the great philosophers attached to the ‘proper’ use of music and the influence they felt it possessed for good or ill. Perhaps some explanation of this power lay in the seamless union with which ancient music and ancient poetry appear to have been joined, each amplifying the potency of the other.



Picture courtesy of the SMT

Anicius Manlius Severinus Boethius, circa 477–524 AD. Born probably in Rome into an old aristocratic line that claimed Roman Emperors in both his mother’s and father’s families, Boethius’ social position ensured that he received a high quality education and a thorough grounding in the classics. At a critical moment in western history, poised between the ancient and medieval periods, and with the knowledge, inclination, wealth and leisure necessary for the task, he set about translating and commenting upon many major works of scholarship from the Greek world still extant and acceptable to the church – Aristotle and the Neoplatonists. Though the project was left unfinished at his untimely death (executed on the orders of King Theoderic of the Ostrogoths) the body of translated work that was accomplished by Boethius would become the major source of ancient learning throughout the medieval period. With regard to music theory, Boethius’ treatise *De institutione musica* represented almost the sum total of the medieval world’s understanding of ancient theory and knowledge. And when the universities of Europe began to develop, his work on music, as well as in many other areas, was incorporated into the quadrivium course of arithmetic, geometry, astronomy and music – the study of number. Boethius’ talents and learning had attracted the attention of Theoderic in Ravenna, and he occupied a number of high government offices in the king’s service. In time he fell foul of political and religious opponents and was accused of treason and conspiracy – in the cause of the Byzantine Emperor Justin. While languishing in prison, awaiting execution, he wrote perhaps his greatest and most personal work, the *Consolation of Philosophy*, a dialogue between himself and ‘Philosophy’ cast in the form of a compassionate woman.

Though the sounds and performance practice of ancient music died away under the combined onslaught of barbarism and Christianity, much ancient music theory survived and became established within medieval

thought, principally through the influential works of Boethius. Working at the watershed between the ancient and medieval periods (circa 500 AD), Boethius' translations and commentaries on a selection of the Greek texts then available – arithmetic, logic, music, philosophy and of course theology – managed to salvage something from the wreck of the ancient world. Later, when the revival of ancient learning began in earnest in the Renaissance, the surviving texts were scoured for all their ancient knowledge; inspiring a new input of theory and speculation, into the vibrant western polyphonic tradition of the fifteenth and sixteenth centuries. Although ancient music theory, as it was understood – the Pythagorean scale and the Greek modes for example – exerted immense influence during the one thousand years that separated Boethius from the tonal era (i.e. 500 to 1500 AD), this influence remained always tangential, almost a parallel universe, to the world of practical musicmaking in the medieval period and beyond. It was only after the middle of the sixteenth century, in the work of Gioseffo Zarlino (and other like-minded scholars) that the old knowledge began to interact meaningfully with current musical practice, as the great theorist and practising composer/musician struggled to reconcile the music of his revered master, Adrian Willaert, with ancient music theory. At last, progress could begin again: open rational minds once more asked penetrating questions about the nature of real living music, and were prepared to accept new answers in return.

MEDIEVAL PERIOD

Tonal harmony did not spring into being suddenly, or through some once-and-for-all revolutionary change of style, in the western tradition. Indeed, to a varying extent elements of tonal organisation are to be found in all music and every tradition. It is a fairly natural and inevitable consequence of musicmaking, and requires considerable effort to eradicate, as the atonal music of Arnold Schoenberg and his followers testifies. However, as outlined at the end of Chapter 2, western music enjoyed a rather atypical development which took it down the path of polyphonic sound spread over a wide range of pitches, and it is through this 'accident' of artistic evolution that the full possibilities of tonal harmony as an organisational principle were to be uncovered. Certainly there wasn't anything preordained in this development; other musical traditions have taken to similar paths to some degree, employing drone accompaniments, parallel melody and all sorts of heterophonic effects, but none were to go as far down this rather narrow avenue of development as the western tradition.

“Polyphony as such, therefore, is not exclusively Western or European; what is distinctive about Western music is that Western composers have specialized in writing polyphony. What in other musical systems is an incidental factor, in Western music is an essential one. We have developed polyphony to a unique degree, and, it must be admitted, at the expense of certain melodic and rhythmic subtleties that are characteristic of the music of other civilized nations, India and China, for example.”

Donald Jay Grout – A History of Western Music¹

The medieval epoch in western Europe was to serve as a long and slow gestation period before the birth of fully fledged, harmonically governed, tonal music. Through the medieval period a number of related elements came together to enhance the likelihood of this outcome. First and foremost, the development of organum: the introduction of polyphonic vocal and/or instrumental 'partnering' melodies to the hitherto solo

Gregorian plainchants. This practice, probably begun as a form of improvised parallel melody, went on to become established and codified, with many additional elements, such as freer motion between and within parts, more than two voices, etc. Over the years from its inception somewhat before 1000 AD, the organum style underwent many changes and developments, with the first named composers known to history being those of Leonin and Perotin of the twelfth century Notre Dame School, centered on Paris. It is interesting that in Europe the quite natural impulse to introduce some form of accompaniment to the chanting of religious texts should take a polyphonic-melodic path, rather than the more common form of a drone or rhythmic drumming, though of course it may just have been chance pure and simple; a possible explanation for this atypical choice might be found in the acoustical environment produced by the architecture of Gothic churches, abbeys and cathedrals. The resonant qualities of these great buildings literally creating something of an organum effect by combining the melodic intervals of plainsong into occasional ‘chords’ through their long echo times. Perhaps this quality was noticed and enhanced by the singers until it eventually developed into a style of chanting – improvised organum. Given the absence of written records of how the practice began, this part of the story will probably always remain a mystery. However, what can certainly still be heard today, is how appropriate the gloriously empty sonorities of the organum style are to their native acoustic. Another related element of medieval musicmaking is the long tradition of building organs in cathedrals and abbeys during the period. The medieval organs were uncontrolled monsters (played with fists and feet) in comparison to the refined instruments of the tonal era. However, despite their wild and thunderous character, with all ranks sounding simultaneously, they significantly covered a remarkably broad spectrum of pitches. For example, in central Germany the Halberstadt organ built in 1361, and described by Michael Praetorius (1571–1621), possessed ranks of pipes sounding across a six-octave range; and significantly, this broad pitch range was carried over into the ‘modern’ organs which were to develop and matured rapidly in the fifteenth century. The extension of music over such wide pitch ranges, which is equivalent to the sounding of many frequencies of the harmonic series simultaneously, was a crucial foundation upon which the tonal revolution, pursued by succeeding generations, would be built.

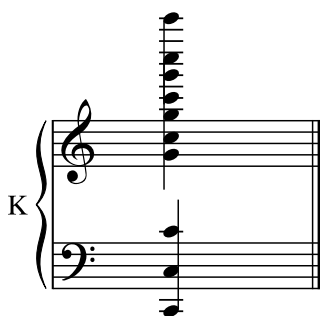


Figure 8.2 The six octave range of pitches produce by playing middle C on the Halberstadt organ, built in 1361.

At the close of the medieval period, during the fourteenth century, a new musical style came to prominence, the *Ars Nova*, taking its name from a treatise by Phillipe de Vitry (1291–1361), where amongst other things, the equal merit of duple meters was recognised, alongside the triple meters predominantly used in organum. Hitherto the development of the organum style had been dominated by musicians working in Paris, but at the end of the middle ages the musical avantgarde spread also to Italy. In France, under the leadership of the poet–composer Guillaume de Machaut (c1300–1377) some of the older practices and

something of the sternness of the old school (*Ars Antiqua*) remained. However, in the warmth and light of Italy, far less emphasis was placed on the scholastic disciplines of the earlier style and a freer more directly harmonic music emerged in the work of Francesco Landini (1325–1397). Overall, the *Ars Nova* can be typified as one of those moments of relaxation (like for example the Rococo period) that often follow long and intense periods of activity, where the stylistic developments become increasingly complex and overwrought. In the secular works of this time, the beginnings of tonal harmony were particularly evident in the fourteenth century practice of *musica ficta*: The altering of modal harmony, particularly at cadences, which brought it significantly closer to the dominant-tonic formula of the period of common harmonic practice. The development of *musica ficta* might be taken as one of the first overt signs of an underlying change in the way music was being aurally processed and understood in minds of European musicians. A revolution was under way, though long and slow in gestation, and now the first tremors were beginning to be felt.

Although music theory lay at the center of academic life in the medieval period, as a member of the quadrivium of subjects: arithmetic, geometry, astronomy and music – the study of ratio in all its manifestations – it rarely made any direct or meaningful connection with practical music making. The medieval view of music theory saw practical music largely as an imperfect reflection of the heavenly order, and theorists principally dwelt on, and attempted to articulate, these eternal verities. This produced a highly abstract and mathematical approach which, in aspects of the *mensural system* – their notational theory – penetrated remarkably far into the core of mutable numbers. Franco of Cologne codified the existing ideas in the second half of the thirteenth century in the book *The Art of Measurable Music* (c.1275) and over the later years of the medieval period, and into the Renaissance, notational developments largely followed the logic of his forward-looking work. The later phase of this development, between 1450 and 1600, is referred to as the period of *white notation* – it is from this time that many of the note shapes and other music symbols we use today originated. One particular area of this system of mensural notation, the theory and practice of durational proportions – a shifting scheme of relative note lengths – essentially encapsulated *the algorithm of symmetrical exchange* which lies at the heart of tonal computation and mutable numbers. A little of this system of proportions has survived to the present day in the *alla breve* time signature – C with a vertical slash. Cogently the theorists classified the modulation exchanges (e.g. *dupla* 1:2, *sesquialtera* 2:3, *sesquitercia* 3:4, etc.), which they applied to the metrical dimension of music alone. However, for the medieval scholars working at a time before the tonal era had even begun, in spite of their having explored so much of the theory and mathematics incorporated within the MOS model of tonality, it was too early for its full significance to be understood. The discovery of tonal computation, when it did come in western music, was to be an intuitive and visceral encounter made by practical composers and musicians, and ironically by then the medieval theory, which could have made sense of their great discovery, had faded from view.

Franco of Cologne, circa 1225–1290. Little is recorded of Franco's life: his place and time of birth and death are unknown. However, by his own accounts, he was Papal Chaplain and the Preceptor of the Knights Hospitallers of St John at Cologne, and other sources suggest he was by birth German. Franco of Cologne's position as the most influential music theorist of the late thirteenth century rests on his principal published work *Ars Cantus Mensurabilis* (c.1250), a treatise which introduced, in essence, the modern system of music notation, where duration is indicated by the note's written form. As is the case with other innovative music theorists, there is strong evidence that Franco was also a practical composer, with links to the Notre Dame School of Paris, though no surviving compositions can be surely attributed to his hand.

Notwithstanding that the rationalist approach to understanding music will primarily look to mathematics and the sciences for explanation – in particular acoustics, physiology, neuroscience and psychology – I must confess to having some sympathy for older medieval perspective of music in the here-and-now reflecting something of the qualities that lie beyond the reach of the mundane: That in the practice of music in the everyday world, in the ritual and struggle of musicmaking, however imperfectly achieved, some glint of apprehension of an innermost logic may be perceived, and savoured, by means of the conduct of arithmetic, in sound.

Johannes Tinctoris, 1435–1511. A native of the Low Countries, Tinctoris spent his early years studying and working at Orleans in northern France, where he eventually held the cathedral position of director of music. Tinctoris is also known to have worked at Cambrai in 1460 where it is speculated that he would have come into contact with Guillaume Dufay. Like many Franco-Flemish composers of the 'Netherlands' school he was drawn to Italy by the many opportunities the country offered, and in 1472 he travelled to Naples. Most of his mature years were to be spent south of the Alps. Johannes Tinctoris was both a practical composer – though very few works have survived – and an ardent music theorist with at least six publications to his name, covering a wide range of topics. In *Proportionale musices* he demonstrates the taste for counterpoint typical of his age – a predilection which came to overlay some of the sweetness of harmony found in the older Burgundian style. A man of many parts, Tinctoris was in addition to his career as musician, theorist and cleric, also a poet, mathematician and lawyer.

THE RENAISSANCE

To start with, it took some time for the system of 'physical' number processing – tonal harmony – to become fully established in the western musical tradition. In the music of the fifteenth century, for example, the masses and motets written by Johannes Ockeghem (circa 1425–1495) still lack the essential directionality which tonal computation brings to music – that forward motion engendered by dominant-tonic harmony. However, in the secular works of the time, for example the chansons of Guillaume Dufay (c.1400–1474) and Gilles Binchois (1400–1460), the flame of tonal computation can be discerned. This dichotomy between coexisting conservative and radical trends would often be repeated in later periods, a dichotomy encapsulated in Claudio Monteverdi's (1567–1643) terms *prima* and *seconda prattica* – the old contrapuntal and new harmonic styles. The development of tonal harmony was somewhat like a self-ignited forest fire: at first there is little to see, a patchwork of trends which might or might not lead on to a fire. In the heat of the day, many areas of woodland lie on the verge of ignition, one or two perhaps achieve a little combustion but then fizzle out in the cool of the evening. As the summer continues, eventually, a lightning strike, or spontaneous combustion in favourable conditions, go on to develop into a fully fledged wildfire. Once the fire gains a hold, and without external intervention, it burns until its fuel is exhausted. This encapsulates the computational view of the history of tonality. At the close of the middle ages the western music culture drew ever closer to the edge of computational conflagration as it wandered down the path of harmonic extension; through composers writing music in many simultaneously sounding parts, producing successions of chords, which for all intents and purposes were successions of harmonic series, more or less complete. From the solo melodies of plainchant, western music developed through the many styles and stages of organum, until by the fifteenth century, and particularly in the secular genre, the tradition reached the point of computational ignition – the intuitive discovery of number processing in musically organised sound – tonal harmony.

At this point, it appears that an English composer played a crucial role in pushing the western tradition over the edge, onto a track that would eventually lead to Bach and Beethoven, and the Beatles. John Dunstable (c.1385–1453) more than any other (though it is perhaps a little unfair to single out one name), is responsible for taking the stylistic tradition of the late middle ages in the direction of the sweet harmonies of the major-third. (There is some evidence for a long parochial tradition in England of organum in thirds – a practice called *gymel*.) The significance of the legitimization of both the major and minor third, leading to their more frequent use (at least in practice if not in theory) as regular harmonic intervals, lies in the crucial positions they have in the harmonic series – between h_4 and h_7 . By filling out the chords with these two intervals, particularly at cadences, the full force of the dominant to tonic sesquitercia 3:4 modulation exchange is felt.

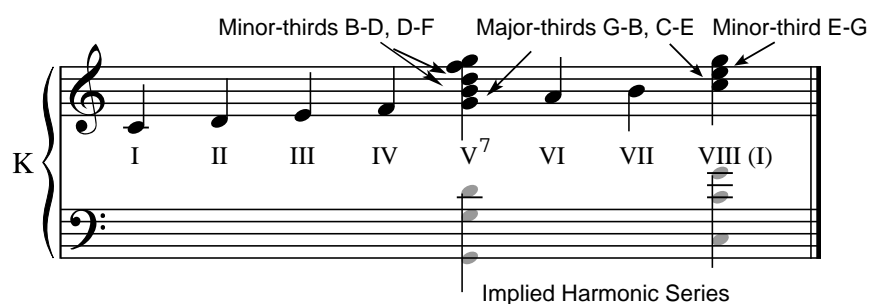


Figure 8.3 A dominant-seventh chord on fifth degree of the C-major scale resolving to the common major chord on the first degree (tonic), a full or perfect cadence.

Tinctoris the Flemish music theorist wrote, in 1475, of music being, “a new art, the source of which was among the English with Dunstable at their head, and contemporary with him in France, Dufay and Binchois”. And this was at the time of King Henry V’s dominion in France, which gave the innovation a chance of catching the mainstream of European musical culture. The trend wasn’t entirely initiated by the English discant style; already in the *Ars Nova* the rather sensuous appeal of thirds had been recognised and exploited. However, the English style accelerated a trend, which went on to be further developed by the composers of the Burgundian school – the vanguard of European stylistic development in the early and middle fifteenth century. The rest, as they say, is history. The Burgundian style evolved into the dominant Franco-Flemish school of the Renaissance, which in time led on to the early and later Baroque, Rococo, Classical and Romantic styles of the period of common (harmonic) practice.

The emergence of the Franco-Flemish or Netherlanders style, in one regard marked a backward step, in that contrapuntal thinking, long dominant in medieval organum, again came to the fore. Indeed, throughout the history of western polyphonic music, a cyclic pattern of periodic harmonic advance, followed by a creeping return of counterpoint, can be discerned. However, over all the cycles, a trend toward greater and more thorough degrees of harmonic organisation is also exhibited. Over the long term, the grip of harmony strengthens perceptibly. Interestingly, one significant route by which counterpoint returned in the early Renaissance involved the manipulation of proportional features of the mensural notation – elements which unknowingly described the processes of (harmonic) mutable numbers. Composers of the time, for example, Johannes Ockeghem (1425–1495), Jacob Obrecht (1452–1505) and the great Josquin des Prez (1450–1521) employed proportional relationships, often hidden behind cryptic performance directions, to play intellectual

games, set puzzles and generally show off their compositional skills. The inevitable result of introducing proportions between parts was to increase the contrapuntal element. The early Renaissance was a time in the stylistic ‘harmony versus counterpoint’ cycle that favored such deepening.



Picture courtesy Wikipedia

Gioseffo Zarlino, 1517–1590. Born in Chioggia, on the south side of the Venetian lagoon, Italy, Zarlino spent his whole life in and around Venice. His early education was undertaken by the Franciscans, with which his family had strong links, and, in due course, he was himself to join the order, rising through the ranks to become in later life a canon at Chioggia cathedral where as a young man he had occupied the positions of lay clerk and organist. As befits a Renaissance scholar Zarlino was a universalist, studying grammar, logic, philosophy, arithmetic, geometry, music and languages under many leading figures in these fields. In music his teacher was the influential Netherlander Adrian Willaert, maestro di cappella of St Mark’s, Venice. And to a significant degree, Zarlino, in this theoretical writing, was attempting to reconcile Willaert’s ‘modern’ style and techniques with the then current theory of music, by extending its compass beyond that inherited from the ancient world (i.e. the Pythagorean view of consonance). In time, Zarlino was to occupy his master’s position as maestro at St Mark’s (1565–90), becoming a teacher of great influence, through the distillation of Willaert’s principles of composition in his widely circulated published works – both in the form of music theory and practical compositions. Amongst Zarlino’s own pupils was Vincenzo Galilei, the father of Galileo.

Soon enough the pendulum was to swing the other way, toward the harmonic principle of organisation, which manifest itself particularly in the secular forms of the late Renaissance: in France the chansons of Claudin Sermisy (1490–1562), Clement Janequin (c1485–1560) and Pierre Certon (c1510–1572); while in Italy accompanied songs of a simple chordal character, called frottole, were much in vogue in the latter fifteenth and early sixteenth centuries. Alongside, and influenced by these simpler harmonic forms, the more conservative contrapuntal tradition of the Netherlanders took on a lighter, more transparent and balanced character, to reach a peak of polyphonic achievement in the late Renaissance, exemplified by the works of Jacob Archadelt (c.1505–c.1560), Adrian Willaert (c.1490–1562), Giovanni da Palestrina (c.1526–1594) and Orlando di Lasso (1532–1594). For a moment, harmony and counterpoint stand face to face in a balanced equality, but however strong the scholarly and learned predilection for the subtleties and complexities of counterpoint, the harmonic principle would not be denied, though time and again, the stylistic course was set towards a theoretical and overwrought contrapuntal coast, the ineluctable attraction of harmonic organisation, acting like a steady undercurrent, would draw the ship of musicians off course, and to itself.

THE BAROQUE PERIOD

With the advent of the Baroque style, harmony finally and unequivocally became the predominant organisational principle in western tonal music. From about 1600 to 1900 AD it would reign and rule supreme; and even Johann Sebastian Bach (1685–1750), probably the greatest and most skilled contrapuntist of the western tradition, subordinated the thread of his melodic thought to the logic of harmonic progression. These three hundred wonderful years of fully harmonic governed music, fall roughly into four sub-spans of seventy-five years each: the Early Baroque (1600–1675), the Mature Baroque (1675–1750), the Rococo/Classical (1750–1825) and the Romantic (1825–1900) periods. Of course, a time frame is only helpful as a rule thumb; many are the exceptions to such hard and fast divisions. However, in tracing the stylistic development of western music through this framework, a further simple rule of thumb might also be helpful: an analogy with literary forms. One could characterise the Baroque style as that of a monologue or lecture, a single linear harmonic argument, pursued with logical rigor (and often considerable vigour) from start to finish, frequently imbuing the music with a strongly directional, and at times mechanistic, character.

The Baroque style grew out of attempts to revive the music of ancient Greece, undertaken by musicians and scholars in Italy, at the close of the sixteenth century. Although little really was known about ancient music, these men of the Renaissance, guided principally by literary scholarship and theory, sought to reconstruct the ancient art in all its imagined purity. The result of their theorising and experiment was *monody*, a highly mannered form of solo song, with an unobtrusive harmonic accompaniment. Though monody was probably not particularly close to their goal, it was an expressive new art form. Effectively they had invented operatic recitative, and the central technique of the Baroque period, the *basso continuo*, the encapsulation of harmony as the dominant organisational principle expressed through a bass line with numeric figures referencing the intended or inferred chord progressions. Their next move would be the invention of opera itself, and this task fell to Jacopo Peri (1561–1633), Giulio Caccini (c1546–1618) and Claudio Monteverdi (1567–1643) amongst many. At the center of this movement for the reformation of music (along what was believed to be the lines of the ancient and original art) were a group of scholars and musicians in Florence, the Florentine Camerata. One of the Camerata's leading members was the composer and scholar Vincenzo Galilei (c.1520–1591) a pupil (and later critic) of the great Renaissance theorist Gioseffo Zarlino (1517–1590), and the father of Galileo. Zarlino's great treatise *Le Istitutioni Harmoniche* of 1558 is the foundational work of modern music theory, where, amongst many advances, he notes that while the major triad arises from the harmonic division of a string or monochord (e.g. 1/2, 1/3, 1/4, 1/5, 1/6 segments – extending the Pythagorean view of consonance in the process to include major and minor thirds and sixths), the minor triad is formed through arithmetic extension in equal segments (e.g. 2, 3, 4, 5, 6). He considered the minor triad to be less perfect than the major because the frequency relationship of the minor-third did not conform to the harmonic mean, as does the major-third in the major triad. Though not affecting these conclusions concerning the nature of the triad, after Vincenzo Galilei and other scholars pointed out errors and shortcoming in the original text, Zarlino had to resort to issuing the *Sopplimenti Musicali* in 1588.

Vincenzo's major published work is the *Dialogue on Music Ancient and Modern* of 1581. He, like Zarlino, was much interested in uniting the theory and practice of music, in a way medieval scholars had not, and conducted musical experiments to ascertain or demonstrate points of theory concerning scale temperament, monody, etc. There have been suggestions that his son, Galileo, might have been influenced by

this empirical approach. In 1588 Vincenzo conducted a number of experiments, perhaps added by his son, which led to his discovery of the exact mathematical formula relating the pitch and tension of a vibrating string. Galileo was at this time living back at the family home in Florence, having left off his mathematical studies at the University in Pisa, and if not directly involved, he must have been aware of, and influenced by, his father's empirical approach and mathematical description of physical phenomena. Here is a remarkable conjunction: the father of modern music theory Zarlino, the birth of fully fledged harmonically governed music in the western tradition and the father of physical theory in European science, Galileo, so closely intertwined. This is not to say that there was some direct causal linkage, but rather that the harmonic system of mutable numbers and the scientific system of mathematical physics grew upon a common foundation – that modern western music and modern western science are siblings.

As so often happens after a revolutionary change, something of the older tradition finds its way into the new system: an accommodation between the old contrapuntal thinking and the new harmonic style occurred in the early Baroque period. A compromise between Monteverdi's *prima* and *seconda prattica* was reached on the strict understanding that counterpoint was henceforward to be subservient to harmony: the new *seconda prattica*. The harmonic principle had now finally entered into its inheritance.

Through the early years of the seventeenth century, it was principally in Italy that this compromise was forged, with the re-entry of counterpoint into the new harmonic style necessarily being achieved in the medium of instrumental music. In keyboard compositions Girolamo Frescobaldi (1583–1643), his pupil Johann Jakob Froberger (1616–1667) and Tarquinio Merula (c.1694–1665) figure in the development of the Baroque idiom and forms, while in northern Europe the techniques of the English late Renaissance keyboard school, exemplified by William Byrd (1543–1623), reached the Dutch composer Jan Sweelinck (1562–1621) through the close contacts between England and the Low Countries and from there passed into the German organ school led by Dietrich Buxtehude (1637–1707) and Johann Pachelbel (1653–1706). However, it was in ensemble music that the Italians of the seventeenth and early eighteenth centuries made their greatest achievements. Foremost amongst many names, are those of Arcangelo Corelli (1653–1713) and Antonio Vivaldi (1678–1741). Corelli, working in Rome, a bastion of the *prima prattica*, developed an assured synthesis of the older contrapuntal style and the new harmonic writing in his many trio sonatas and other works. Corelli's larger-scale concerti grossi were only published after his death but were written and performed well before 1714, and, with contributions from composers of the Bologna school, for example Giuseppe Torelli (1658–1709), the concerto form passed into the versatile and adept hands of Vivaldi, working in Venice. The mature Baroque style, of which Vivaldi was the first great master, had arrived.

The influence of the Italian innovations and the prestige of their achievements at this time was felt in all corners of Europe. The convention of using the Italian language for written directions in scores stems from this long period of pre-eminence. From the late Renaissance through the early Baroque, Italy was the cockpit of music, drawing musicians and composers from across Europe to its enriching fount, and radiating the new style to other lands, as many Italians found employment abroad. Quite early in the period, Jean-Baptiste Lully (1632–1687), Italian by birth, took the new ways to France, where he skilfully adapted them to the language and tastes of the French. Later Jean-Philippe Rameau (1683–1764) and George Frederic Handel (1685–1759) studied and/or worked in Italy early in their careers, the latter particularly assimilating the ways of the Italian Baroque, which he took to an England denuded by civil war and the death of Purcell.



Picture courtesy Wikipedia

Jean-Philippe Rameau, 1684–1764 was born in Dijon, eastern France, the son of the local organist. The record of Rameau's early life has significant gaps, and, until he attained some measure of success in Paris in mid life, the story is incomplete. It is believed that his only formal musical education came at his father's hand, and indeed, that his general education was rather meagre. It is known that he briefly travelled to Italy in 1701 and around this time held the post of organist at Clermont-Ferrand in central France. In 1706 Rameau moved to Paris where he attempted to establish himself as a composer and teacher, publishing a set of harpsichord pieces. However, success at this time eluded him, though the experience of teaching thorough-bass technique – the essential skill for this period of improvising a keyboard accompaniment from a bass line with numbers indicating which intervals to employ – perhaps helped to crystallize the ideas that were to form the basis of his theories later on. Little is known of the years from 1706 except that at some time after 1715 he returned to the post of organist at Clermont-Ferrand. By this time Rameau had assimilated the prevailing concepts of current harmonic theory, rejecting some like the rote approach of the 'rule of the octave', while accepting and building on others, in an attempt to find a rational basis for the intuitive choices he made both as composer and accompanist. In 1722 the *Traite de l'harmonie reduite a ses principes naturels* (*Treatise on harmony reduced to its natural principles*), the first of his many publications appeared, gradually making a name for Rameau as a music theorist. And in 1723 he returned to Paris determined to try again to build a career as a composer. It was to take a further eight years of effort before the breakthrough came, by way of the patronage of the noble and extremely wealthy 'La Poupliniere' – Alexandre la Riche de la Poupliniere. From 1731, with his patron's support and at the late age of forty-eight, Rameau's career as a composer at last began to make progress, with the 1733 production of *Hippolyte et Aricie*, his first large-scale success. Further operas and opera-ballets followed. However, success in composition neither deflected nor diminished Rameau's striving to explain, in rational terms, the fundamental nature of music. He continued to develop and refine his theories to his last days, leading to many further publications and a certain lack of focus as to his ultimate conclusions. His character has often been drawn as solitary and taciturn, but perhaps this stemmed from an awkward shyness, born in part from a provincial upbringing and the marks left by the many long years it took to establish himself. Though the doggedness with which he pursued an ultimate theory of music, never content to rest at any set of conclusions, indicates a certain obsessive cast of mind. Perhaps the high point of his career as music theorist came with his address to the French Academy, where he outlined his theory of music, and for which in part he gained the accolade 'the Newton of music', a recognition of achievement which one senses he long and deeply craved. Despite success in composition and theory, and a reasonable prosperity, detractors and critics abounded. In later life considerable amounts of Rameau's time were taken up embroiled in the arguments and controversies of various intellectual and artistic factions. He was never an easy man to know or befriend, and few if any then (or many since) could see beyond his awkwardness of manner, both in his life and his writings, to recognise and acknowledge the full profundity of his achievement.

Rameau had a dual career, first as a music theorist and later as a highly successful composer, and, as his compositions were written in maturity, they owe somewhat more to his French instincts than might the works of a younger man freshly returned from the Italian sun. As the foremost French composer of the late Baroque

period he is justly esteemed, but this achievement has overshadowed an equal or greater achievement in music theory. Throughout a long life spanning the height of the French Enlightenment, Rameau strove to construct a theoretical synthesis for music, comparable to that which Newton had provided for physics. In many publications, of which the *Traite de Harmonie* of 1722 is the best known, Rameau set his theories in the broader context of general musical practice, i.e. composition and the art of figured bass accompaniment (derived from monody). It is perhaps significant that, like Zarlino, he was a practical composer, as well as theorist seeking the underlying principles which guided his artistic choices. Implicitly Rameau believed there was a rational basis to empirical musical practice – the intuitive choices of composers and musicians – and he devoted this life to discovering what that ground might be. Though he was ultimately unable to bring his ideas to a fully satisfactory conclusion, Rameau made large strides toward a complete theory of tonal music. Often relying on the work of others, as well as his own thoughts and ‘experiments’, he ascertained 1) the foundational role of the *corps sonore*, the default vibrational pattern of an oscillating body (i.e. the harmonic series) as the ultimate source of musical phenomena, 2) the nature of the rootedness of chords in the *basse fondamentale*, 3) the common identity (through the fundamental bass) of chords whether in root position or inversion and 4) that melody is essentially an expression of harmony in linear form. All, except perhaps the last proposition, have been generally accepted since his day as major elements of modern harmonic theory. Statements 2), 3) and 4) above, logically flow from statement 1) regarding the *corps sonore*: chords are configurations of harmonic frequencies (partials) implying a fundamental frequency, a root. Where Rameau, as others, experienced difficulty (for example, Jean le Rond d’Alembert, a mathematician and sometime collaborator with Rameau) was in accounting for the nature of the minor chord, with a similar degree of elegance as the major triad emerges from h1C, h3G and h5E of the harmonic series. To achieve an explanation Rameau was forced to resort to a somewhat arbitrary assumption about an arithmetic series being ‘suggested’ by the harmonic relationships of the *corps sonore*, which then could be used to generate a descending sequence from the fundamental: h1C, h1/3F and h1/5Aflat.

$$\begin{array}{l} \text{Frequency: } A\flat h^{1/5} \leftarrow Fh^{1/3} \leftarrow Ch1 \rightarrow Gh3 \rightarrow Eh5 \\ \text{Wavelength: } A\flat\lambda^5 \leftarrow F\lambda^3 \leftarrow C\lambda^1 \rightarrow G\lambda^{1/3} \rightarrow E\lambda^{1/5} \end{array}$$

Figure 8.4 The major (ascending) and minor (descending) triads emanating from a single fundamental Ch1, illustrated in ratios of frequency and wavelength.

Rameau had marvellous theoretical instinct, perhaps in part stemming from his compositional gifts, which helped him to make such remarkable progress overall. However, although his instinct had essentially led him correctly to the door of the conundrum, he lacked the key to unlock the secret of the minor chord. Like Zarlino before him, the arithmetic relationship associated with the minor chord hung tantalisingly close to convincing explanation, yet still proved to be beyond reach. Zarlino had delineated the relationship in 1558, now two hundred years later, Rameau had set the arithmetic series within the context of the *corps sonore*, but below the fundamental.

The next major step towards understanding the minor chord would not come for another hundred years, but two mathematicians were to make contributions in the meantime: Leonard Euler in relating consonance/dissonance to the lowest common multiple of note frequencies and Joseph Fourier in discovering that any

complex periodic wave pattern, including musical sound, can be reduced to a set of simple (integer frequency) sine waves of varying intensity, i.e. parts of a harmonic series. Fourier's work demonstrated that each harmonic 'frame' of a composition, ultimately reduced to a single (probably extensive) harmonic series.

Handel made the pilgrimage to Italy in 1706, furthering his already formidable compositional technique, which he applied to opera and sacred music while there. He met Corelli and the Scarlattis, both father and son, absorbed all he heard while travelling widely, and in 1709 managed to have his opera *Agrippina* performed in Venice. J.S. Bach never made the journey to Italy (though as a young man he walked 250 miles to hear Buxtehude play in Lubeck), but he is known to have closely studied many of the works of Vivaldi, and also the great French keyboard composer Francois Couperin (1668–1733), thoroughly assimilating the techniques of both countries. The great achievements of J.S. Bach, too numerous and well known to rehearse in full here, were to mark the close of the Baroque period. Almost every form Bach touched, he enriched, often fulfilling and rounding out the lines of development begun earlier in the Baroque period, for example the *Chorale Preludes* and *The Art of Fugue*. In the two volume collection of forty-eight preludes and fugues, *The Well-tempered Clavier*, filled with pieces written in each of the twenty-four major and minor keys, Bach demonstrated the utility of the complete cycle of key relationships. That is, the logical extension of harmonic computation, through the most powerful of the modulation relationships – the secondary sesquitertia 3:4 exchange – into a closed system of twelve tonally related sub-systems: the twelve major and minor tonal centers. The achievement in the mature Baroque of not only a comprehensive form of harmonic structuring founded on a single fundamental frequency (a key/tonal center), but also the extension of that organisational principle to a cyclic system of harmonically related structures (tonal centers) probably marked out the approaching zenith of mutable base position-value number processing in western music.

At about this time Giuseppe Tartini (1692–1770) a virtuoso violinist and composer of music which foreshadowed the Rococo style, made a remarkable discovery – difference tones: the impression of a lower frequency, i.e. bass note, created through the asymmetry of the ear, by two higher sounding notes, sometimes justifiably called Tartini tones. As a virtuoso violinist and teacher he found these 'virtual' bass notes useful in regulating the intonation of double stops, pairs of notes played simultaneously. For music theory the significance of Tartini's discovery of difference tones is that they demonstrate that the ear and processes of aural cognition are constructed so as to sift out the root note of major chords – the fundamental period or octave transposition thereof – but perhaps crucially, to isolate the note a major-third below the root of minor triads. Here, perhaps, lay a significant clue to unravelling the mystery of the minor triad.

Tartini's discovery also lent additional credence to Rameau's theory of the fundamental bass, which was itself an outgrowth of the earlier Baroque invention of the figured bass (i.e. monody). Here lie the origins of two pervasive strands of thought: Rameau's identification of harmony and chord progression at the center of tonal music, while other more conservative theorists preferred to maintain and develop a traditional approach based on scales. The former, deductive in character, focusing on the vertical relations of harmony, and the latter descriptive, melodic and more 'horizontal' in outlook. Rameau, and his theoretical heirs, e.g. Hugo Riemann, aspired to understanding the processes of harmony, the *functions* of chords, rather than contenting themselves with taxonomic enumeration. However, it was from among the scale theorists, that the immensely versatile Roman numeral (I, II, III, IV, V, VI, VII) *scale-step* approach emerged, first systematically developed by Gottfried Weber (1779–1839), and soon universally recognised and adopted.

Notwithstanding the utility of Weber's labelling scheme, it unfortunately doesn't enlighten or inform the theorist-musician as to why the chords behave as they do. The challenge for the more ambitious functionalists is to find a rigorous theory of harmony that can both explain the nature of chord progression, and simultaneously subsume within its contours the patently successful Roman numeral approach. Though Weber himself strongly rejected any idea that his scale degree labels could, or should, convey any prescriptive information concerning the functions of chords, over time, a functional aspect has gradually attached itself to his system. (See Chapter 16 – Appendix A, for a fuller account of Roman numerals.)



Jacob Gottfried Weber 1779–1839, was born at Freinsheim, Rhineland-Palatinate, Germany. From a young age he showed an interest in music and played the flute with skill. After early schooling, Weber went on to study law at Heidelberg and Göttingen, graduating in 1802. Throughout his life, while pursuing a demanding career in the civil service and the law, at Mannheim, Mainz and later Darmstadt, Weber also indulged an interest in music teaching, composition and music theory. Longstanding friend of his namesake, the composer Carl Maria von Weber, J.G. Weber was a man of many parts: concert promoter, overseer of local theatres, church music reformer and judge. In 1824 he founded the influential music periodical *Cacilia* (published by Schott at nearby Mainz), of which he was the editor until his death in 1839. Through this rather scholarly and conservative journal, he promulgated both his musical tastes and his trenchant views on music theory. Also published by Schott was Weber's principal theoretical treatise *The Theory of Musical Composition (Versuch Einer Geordneten Theorie Der Tonsetzkunst)*, in three and four volume editions, where he introduced the systematic use of Roman numeral labelling of chords, by reference to their roots, and confronted its accompanying corollary of multiple meanings (i.e. different functions) for each label. For example, chord V in the key of C major, is chord I in G major and III in E minor. As with Rameau, Weber's direct experience as pedagogue and composer perhaps exerted a significant influence on his theoretical thinking. Gottfried Weber died at Bad Kreuznach on 21st September, 1839.

THE CLASSICAL STYLE

After 150 years of near continuous development culminating in the masterful, highly wrought works of J.S. Bach, there was a short period of relaxation – the Rococo era – ushered in as a reaction against such complexities, this a new 'naive' style was imbued to a large degree with the Enlightenment's fascination with the pastoral idyl. The Rococo or 'galant style' proved a brief but decisive interlude, in that the grip of contrapuntal thinking, which had lasted throughout the Baroque period in a subservient role to harmonic organisation, was finally shaken off completely. Quite quickly, the Rococo ideals of simplicity and elegance, expressed almost entirely in purely harmonic form – chord progressions and expressive melody, harmonically governed – deepened and matured into the Classical style. In the analogy made with literary form, the change that occurred from Baroque to Classical styles is that of monologue to *dialogue*. What has

been characterised as a Baroque lecture, metamorphosed into a Classical discussion or debate. The extended linear harmonic logic of the Baroque monologue was chopped up into little pieces and stuck back together to form a multi-faceted Classical collage, with a sense of balance and contrast holding the ring between competing ideas. The dialogue principle provided a highly flexible and adaptable formula with a tendency to favor shorter themes and motives, which could fill out the underlying harmonic progressions with a necessary level of interest and ‘activity’ – much as the longer lines of contrapuntal writing had done in the Baroque style. This basic formal invention, Classical sonata form, could span both the small and large scales, from a short discussion between strangers on a street corner or even a conversation with oneself (i.e. the unaccompanied solo sonata), to a town meeting or great parliamentary debate. The essence of sonata form was simplicity itself: character one makes a statement or proposition, character two disagrees and makes a more or less contrasting declaration, they proceed to discuss and debate the relative merits of the two ideas, finally coming to a resolution or accommodation of some sort, the conclusion. The musical driving force to impel the two characters’ arguments along lay readily to hand in the dominant-tonic chord progression – the most powerful of the modulation exchanges. And with the Baroque legacy of the fully developed cycle of key relationships, the contrasting propositions of the sonata-debate form could be articulated as conflict, tension and resolution between different keys. The Classical symphony represents the ultimate large-scale form, based on the principle of tonal dialogue, but such a scalable method could be used throughout the range, e.g. piano sonatas, string quartets and concertos. Symphonies would continue to dominate the musical landscape well into the twentieth century, though composers would on occasion feel the need to supplement the form with narrative features, leading in the later Romantic period to the symphonic poem.

The changeover from Baroque to Classical occurred in the time of J.S. Bach’s many musical children: Carl Philipp Emanuel (1714–1788), Wilhelm Friedemann (1710–1784) and Johann Christian (1735–1782), to name but a few! And in the Germanic lands, the Rococo took the different and rather more intense character of the *empfindsamer stil*, a somewhat more ‘romantic’ version of the style. A fusion of the lighter, essentially French strain of the galant, with the expressive German style, yielded the Classical amalgam of expression bounded by an elegant restraint, the instincts and ideals of the eighteenth century enlightenment expressed in music.

The core works of the Classical period are to be found in the compositions of Franz Joseph Haydn (1732–1809) and Wolfgang Amadeus Mozart (1756–1791), the former experiencing a gradual and extended development of the possibilities of sonata form while the latter, comet-like, illuminated the creative firmament with his astounding gifts, all too briefly. They were personal friends, each regarding the others work with high respect, and at different periods of their careers they influenced one another – as also did the music of Haydn’s brother, Michael Haydn (1737–1806) and of course others to a lesser degree. Joseph Haydn is generally regarded as the father of the symphony, and in his long years of service on the isolated Esterhazy estates he gradually developed the new form, as he simultaneously honed his own compositional skills. In all he was to write over one hundred symphonies while Mozart’s last, the Jupiter, stands at forty-one. The works of Ludwig van Beethoven (1770–1827) also fall within the Classical period, and though influenced to a degree by the work of his contemporaries, his musical thought tended to be much more individual. In music as in life, Beethoven was his own man. Though he only produced nine symphonies, they are of a scale and stature which took the symphony beyond its purely classical form. However, it would not

be true to say that Beethoven had no regard for the music of others; often he would seek out and study the scores of his fellow composers.

Indeed, right at the zenith of the tonal era, in the Classical period, the principal composers of the time, Haydn, Mozart and Beethoven, all began to look back to the previous generation, valuing what came before, and this trend was only to intensify in later years. For example, Mendelssohn's role in the promotion and republication of Bach's music, or Beethoven writing to F.A. Hoffmeister² in January, 1801:

“Your desire to publish the works of Sebastian Bach is something that really warms my heart which beats sincerely for the sublime and magnificent art of that first father of harmony.”

This change of attitude to the music of past ages is significant. In earlier periods, that is until the full emergence of tonal harmony in the Classical period, music was very much an art of the moment. Up to this time, the musicians of the day made and performed music of the current time; hardly anyone one considered playing the old music of former generations. (There are a few exceptions from earlier times but the general trend is what is important.) The current ‘modern’ style, whatever that style happened to be at that moment, was more or less, all of music. Innovation and fashion could keep the current style fresh by ‘moving on’, thus constantly relegating the music of earlier times to oblivion. For example,

“Tinctoris [Flemish music theorist] in 1475 thought that no music worth hearing had been written before 1440; the Swiss theorist Glarean in 1547 was persuaded that no one could ever surpass the music of Josquin des Prez (d. 1521); for Zarlino [...] writing in 1558, the acme of musical art was reached in the works of his contemporary, Willaert...”

Donald Jay Grout – A History of Western Music¹

However, at this peak in the story of tonal music, and perhaps more generally throughout the eighteenth century, something very different was beginning to emerge in western music: tonally organised harmony was showing itself to be something more powerful, wide ranging, and altogether rather different from a ‘mere’ style or fashion of the moment. What had apparently grown up almost unnoticed, was an aural mode of thought and communication, the language of numbers expressed in sound. Once the language became established in the minds of musicians and the general populous, two effects were to become discernible. First, they could if they wished, apply the same mode of aural processing to the tonally organised music of former generations with equal satisfaction, once the small obstacle of the cliches and mannerisms of the older style had been assimilated. And, second, although this would not become apparent until the twentieth century, the majority of members of the western tradition would show themselves extremely reluctant, not to say highly resistant, to abandoning their tonal language for any other mode of aural expression and communication. Western music was no longer simply a succession of *styles*, it had become a *continuum* of tonally organised music, clothed in a succession of outwardly differing stylistic expressions. Today, after more than 100 years of hard labor, expended by countless idealistic composers and musicians, advancing almost every conceivable variation of contemporary non-tonal style (or even language), the vast majority in the western tradition, plus many new recruits from other music cultures, have hardly budged an inch in their predilection for tonally organised music: aural (mutable base) number processing.

THE ROMANTIC PERIOD

The change of style wrought by the Romantic movement in the nineteenth allowed something of a *new face* to be placed over the mutable number system, but the heat from the fire was dying, the fuel supply – novel extensions to the system of harmonic computation – was rapidly being depleted. The change from Classical to Romantic style, to continue the analogy used above, was rather like changing the mode of expression from prose dialogue to impassioned poetic recitation. The basic grammar and vocabulary of the language of tonal computation remained much the same, but the way these elements were used, declaimed, changed considerably. As in poetry, not only what is said, but how it is said, is important in ascertaining and understanding the message. Great dynamic contrasts were introduced which might imbue simple chord progressions with intense meaning, sudden changes in tempo perhaps illuminate the troubles of the artist's soul! The cool and measured detachment of Classicism was exchanged for the luxuries and licence of self-expression, a limitless yearning for the unknowable and unattainable. The trend began with Beethoven, towering over the Classical achievements of his contemporaries in Vienna, whilst also foreshadowing the expressive objectives of the generation to come. However, for all the intensity of Beethoven's music, he rarely lost sight of the need to maintain a disciplined approach to form. While exerting a huge influence on the Romantic composers, he was not one of them.

In the years after Beethoven's death, Robert Schumann (1810–1856), Franz Liszt (1811–1886), Hector Berlioz (1803–1869) and Peter Ilyich Tchaikovsky (1840–1893) carried the vanguard of emotion forward, while Felix Mendelssohn (1809–1847), Frederic Chopin (1810–1849) and Johannes Brahms (1833–1897) tempered their work with a degree of Classical restraint, as had Franz Schubert (1797–1828) earlier. Perhaps Richard Wagner (1813–1883), Gustav Mahler (1860–1911) and Richard Strauss (1864–1949) were the last to extract a little new heat out of the dying embers, before the fire of novel extensions to the language of tonal computation were to be extinguished in western art music. The central engine of tonal harmony, the simple dominant-seventh/tonic relationship, by this time had been overlaid by many extra intervals, dominant-ninths, elevenths, thirteenth, as each generation strove to extend the language and exploit new relationships. However, not unlike the process of nuclear fusion which powers the stars, this approach is one which yields declining returns. These ever more complex chords become increasingly difficult for the ear to unravel, giving progressively less sense of directionality to the music. Mirroring the gradual loss of tonal direction through the nineteenth century, composers, again taking a hint from Beethoven (the Pastoral and Choral symphonies), began to compensate for the weakening of the *absolute element* of firmly perceived mutable number processing, by introducing programmatic and narrative features into their works. This trend was to culminate in the forms known as the symphonic poem (Strauss) and music drama (Wagner). These gigantic compositions written at the end of the Romantic period, scored for huge orchestras, perhaps convey something of a sated melancholy and nihilism often associated with the end of an era – the end of the tonal era.

The nineteenth century brought great advances in acoustics and music theory, and two great individuals, one associated particularly with the former was Hermann L.F. von Helmholtz³ (*On the Sensations of Tone, 1863*) and with the latter Arthur von Oettingen⁴ (*The Dual Harmony System 1866/1913*). Both were scientists and talented musicians, but not composers. Helmholtz (1821–1894) exemplified the

dispassionate scientific approach of careful experiment, leading to theoretical conclusions; it was he who discovered the (still disputed) existence of summation tones. On the conundrum presented by the minor triad he concluded that it must in some way be a secondary and synthetic phenomenon, derived from the major principle embodied in the lower ratios of the harmonic series. He proposed for its derivation 1) the idea of two series, superimposed, (e.g. series built on C-h1 and Eflat-h1 to underlie the C-minor triad) or alternatively, 2) that the minor-third is a foreign tone within a single series derivation. So near and yet so far: as the police know well, two different alibis are no alibi at all! Crucially, Helmholtz did not put the two alternatives together. If he had, it would have yielded the structure of one harmonic series nesting within another (alternative 1), with the awkward minor-third a foreign tone in the nested series (alternative 2) but a native tone in the fundamental nesting series (see Figures 1.17 and 1.18).



Picture courtesy Wikipedia

Hermann Ludwig Ferdinand von Helmholtz, 1821–1894. Born at Potsdam, the son of a school headmaster, the young Helmholtz showed a marked inclination for the natural sciences. Originally intended for a career in medicine by his father, Helmholtz's devotion to research drew him toward his undoubted scientific vocation. While studying in Berlin he worked with Max Planck the father of quantum theory and A.A. Michelson whose experiments measuring the speed of light were to be crucial to twentieth-century physics. Helmholtz contributed original research in many areas – thermodynamics, sensory physiology, ophthalmics and electromagnetism – and in 1863 he published a penetrating and influential book on acoustics and auditory perception: *On the Sensations of Tone as a Physiological Basis for the Theory of Music*. As befits a keen student of the senses, he was a good amateur pianist and sensitive musician who found the compromise of equal-temperament difficult, indeed painful to bear. Through his experimental skills, designing and improving instruments for detection and measurement of sound, Helmholtz discovered the existence of summation tones: ghost tones created within the mechanisms of the ear, similar to the stronger difference tones first noticed by Tartini. He designed a harmonium for the study of overtones and a detector which bears his name – the Helmholtz resonator – which he used in his research into the nature of consonance and dissonance: the key to which he believed lay in the interaction of the fainter, higher harmonics. Helmholtz concluded from his research that the ear was more complex in its workings than had previously been thought, and put forward a hypothesis of the ear as a non-linear mechanism. That is to say that the connection between objective aural stimuli and what we perceive is not a simple or directly linked relationship; there are discontinuities and complex relationships between input and output. One area of criticism leveled at his work was that it was rather atomist in its approach, focusing on sustained and isolated sounds, taking little account of music as a dynamic sequence of stimuli. In 1871 Helmholtz was appointed Professor of Physics at the Humboldt University in Berlin, where he remained, laden with honours in later years, until his death.

In contrast to Helmholtz, and building on the earlier philosophical approach of Moritz Hauptmann⁵ (*The Nature of Harmony and Metre, 1853/1873*) and Helmholtz's own work, von Oettingen (1836–1920) developed Rameau's intuition concerning the descending structure of the minor triad forming an arithmetic mirror image of the ascending major triad. Oettingen noticed that the overtone series of the constituent notes in the minor triad had a common partial two octaves above the fifth (e.g. h10E, h12G and h15B all share the common partial h60B) and that this shared overtone structure is matched, in reverse, by the harmonics below the major triad (eg. h4C, h5E and h6G all share the common fundamental h1C). Rameau had placed the minor triad below the fundamental tone of the major triad and derived it by 'suggestion' from the ascending series; now Oettingen proposed that the minor triad should be considered as having an equal and independent status with regard to the major triad, with its own downward operating, 'phonic', generative principle.



Picture courtesy Wikipedia

Arthur (Joachim) von Oettingen, 1836–1920. Born into a noble family with scholarly traditions, originating from southern Germany but long resident at Tartu, Estonia (then Dorplatt, Livonia), v. Oettingen studied sciences first at the University of Dorplatt and later in Berlin and Paris. Returning to Dorplatt in 1863, he completed his teaching qualifications and took the post of Professor of Physics at the university in 1866. (Two brothers Georg and Alexander were concurrently Professors of Medicine and Theology.) The same year saw the first publication of his theory of harmonic dualism – *Harmoniesystem in dualer Entwicklung*. Oettingen continued to refine his radical ideas on harmony and published two further accounts in 1902–6 and 1913, as well as numerous articles in the fields of physiology and physics. He held the chair of physics at Dorplatt until his retirement in 1894, and throughout his tenure was active in local scientific and musical societies. A keen musician, Oettingen was president of the Dorplatt musical association and director of an amateur orchestra. His retirement years were spent in Leipzig, where he held an honorary professorship; during these years the two later statements of the theory were published.

Oettingen never expressed his ideas in a way contrary to the accepted principles of acoustics – though some of his more ardent supporters did at times, Hugo Riemann for example. However, the basic stumbling

block to the acceptance of this elegant theory of mirror triads with ascending major ‘tonic’ structures and descending minor ‘phonic’ structures, is the plain fact that the ear cannot recover wavelength information in this way, and so does not recognise descending phonic structures as such. Although harmonic dualism, to use Oettingen’s chosen term, experienced a considerable vogue in Germany in the late nineteenth and early twentieth centuries, it eventually became discredited, as no way around its fatal flaw could be found. Again intuitive insight had led up to the door of the minor paradox without the key to unlock it being found.

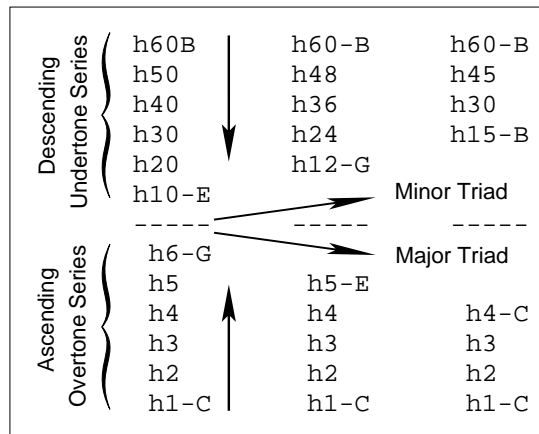


Figure 8.5 The major CEG and minor EGB triads derived as overtones of h1-C and ‘undertones’ of h60-B.

Hugo Riemann was probably the most influential and versatile music theorist of these times, he wrote widely on almost every musical topic, and in his writings he attempted to incorporate Hauptmann's and v. Oettingen's dualistic harmony within a more or less complete music theory. Riemann adopted Oettingen's notation and further developed the implicit harmonic relationships which emanate from a dualist approach, into a fully fledged account of harmonic progression in tonal music. This took the form of a theory of chordal *function* expressed in relation to the tonal center – the tonic chord. The general notions of Riemann's harmonic functionalism would establish themselves, almost universally, as the standard method of harmonic analysis in the twentieth century, through the attachment of his ‘functional dynamics’ to Weber's Roman numerals. Thus in the minds of music theorists and analysts a descriptive Weberian chord sequence like, for example I vi ii V I, would take on a dynamic directional connotation, impelling the phrase towards the cadence. Also to be of great influence, in the second half of the twentieth century, was Hugo Riemann's development of dualism's implicit creation of a relational harmonic ‘space’ – first articulated by Oettingen. Riemann's representation of a tonal network (tonnetz) of nodes and transformations based on the functional relationships of tonic, dominant and subdominant (extended to include secondary chords as well) would prove a fruitful starting point for the mathematically minded ‘Neo-Riemannian’ theorists of recent years.

Riemann struggled throughout his career to overcome dualism’s central weakness, but in the end he had to admit defeat and settle for theoretical and psychological arguments – unbending science would not allow the existence of an objective generative undertone series. In this regard, his conclusions mirrored his great predecessor, Rameau; in addition to which, the character of Riemann’s career-long refining and revising of his theoretical precepts, expressed in numerous books, also finds an echo. The range and volume of Hugo Riemann’s thought and writings are encyclopaedic, covering almost every aspect of music: harmony, counterpoint, meter, rhythm, notation, performance, historical topics, music psychology, etc. To name only a

small portion! Of particular significance was his foundational work in the field of musicology, where he pioneered with others (e.g. F. Chrysander and G. Adler) research into, and publication of, the historic canon of tonal music. From its beginnings earlier in the nineteenth century, the growth of interest in the music of previous generations of composers was accelerating, as musicians and the wider musical public found that their common musical language – tonality – gave them access to a historic archive of untold riches. In 1850 the founding of the Bach-Gesellschaft society, dedicated to unearthing and publishing the then almost unknown works of J.S. Bach (a task that was to take half a century and more), was a milestone and signpost to the future. Right up to the present day musicians, music scholars and historians have been toiling to salvage, research and perform almost every last remnant of our musical inheritance. Gradually the mists of oblivion have been beaten back, as the forgotten music, the forgotten instruments and the forgotten performance practice of previous centuries has been excavated or reconstructed. Of first concern were accurate scores, but later, concern for authenticity extended to the types of instruments and the styles of performance that might be appropriate for historic works. Over time the horizon has been pushed back ever farther; for example, Monteverdi, whose music was unknown before 1950 is now seen as a central figure and today one might reasonably expect to hear performances of Landini or Leonin. All this raises the question: Why are we, unlike earlier generations in the western tradition, so interested in the music of the past?



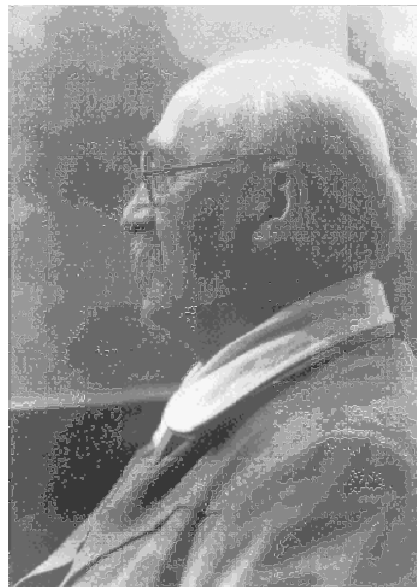
Picture courtesy Internet

Karl Wilhelm Julius Hugo Riemann, 1849–1919, the son of a prosperous landowner and music lover, was born at Grossmehlra near Sondershausen in Thuringia, Germany. He was educated at local schools and his talent as a pianist was nurtured with lessons from distinguished music teachers. Riemann travelled to Berlin and Tübingen universities, where he first studied law, and later, literature, history and philosophy. As a young man he served in the army during the Franco-Prussian war of 1870–71. Attracted by the creative arts, Riemann had hoped to make his way as poet but failed to find a publisher. He also tried his hand at composition, however, where Riemann found he could make a mark, was in his writings on musical topics. His first publications appeared under a pseudonym in the *Neue Zeitschrift für Musik*. (Here again, some connection may be discerned between the experience of a creative artist and new, insightful, theoretical thinking). After leaving the army he set his sights on a musical career and chose to study at the Leipzig Conservatory. In the years up to the turn of the century Riemann held a number of teaching posts around Germany while also producing a stream of voluminous writings on a wide range of musical topics, e.g. *Musiklexikon*, *Vereinfachte Harmonielehre*, *Gross Kompositionslehre*, etc. He married Elizabeth Bertelsmann in 1876, with whom he had five children. Gradually his reputation and influence as a music critic, theorist and musicologist grew, at first within Germany and later throughout Europe and North America. In 1901 he returned to Leipzig as a professor. In 1908 he was appointed as the founding director of the *Collegium Musicum* musicology institute and, in 1914, founding director of the *State-Saxon Research Institute for Musicology*. Hugo Riemann died on the 10th July, 1919 in Leipzig.

THE TWENTIETH CENTURY

As with the author of *Huckleberry Finn*, reports of the death of tonal music around the turn of the twentieth century had been greatly exaggerated. Though composers had finally extracted and exploited every peripheral chord progression from the system by the end of the nineteenth century, and generally felt that the time to ‘move on’ had arrived, the western musical culture en masse saw it differently. Over the preceding centuries a language had grown up, been acquired and thoroughly assimilated by the tradition; any attempt to usurp its role or arbitrarily impose another language was as likely to succeed as an act of Congress substituting Esperanto for English as the national language of the USA. What some composers of the twentieth century failed to grasp or simply ignored, was that tonality is (or had developed into) a language and was not simply a (superficial) style. The rules of the game had changed fundamentally: in regard to the choice of the language of musical communication, they, the composers, were no longer in the driving seat.

Composers are of course entirely at liberty to use other languages, invent new languages or make whatever innovations they please, and some of the bravest have done just that, but the inevitable consequence of such a course of action is that their music will only be intelligible to a tiny minority, their efforts condemned to the sidelines – ivory towers and musicology. (Historically, when art music was the preserve of a small elite such prescriptive, ‘top-down’ developments might possibly succeed, but not in a modern democratic mass society.) Most twentieth century composers took the more practical middle way, blending greater or lesser amounts of the common tonal tongue with new features or borrowed elements from other or earlier traditions. And this approach, generally produced outcomes somewhat along the same lines as that of the late Romantic period, in that the music naturally lacks the clear tonal focus of earlier periods, though of course expressed in a wide variety of new, often energetic or even abrasive, styles.



Picture courtesy Internet

Heinrich Schenker 1868–1935, was born into a Jewish family living at Wisniowczyk in the border region between modern day Poland and Ukraine, then a far corner of the Austro-Hungarian empire. His early education was carried out there and at Lemberg (L'viv) where his ability as a pianist brought him to the notice of Carl Mikuli, a former pupil of Chopin. In 1884 Schenker began a six-year course of study in law at the University of Vienna; during the later years of his course he found time to enrol at the Vienna Conservatorium, where his teachers included Anton Bruckner. Like

most music theorists, Schenker was originally drawn to composition, but perhaps for both financial and artistic reasons, he found music journalism combined with piano teaching and accompanying, a practical alternative. For the remainder of his life, he stayed in Vienna, married, and pursued a varied career as a practising musician, writer and teacher. Schenker's ideas about music theory and analysis grew out of his concern as a conscientious musician for accurate scores and sympathetic, insightful performance. He published many thoroughly researched scores with comments and annotations. Over the years, his theoretical thinking evolved towards a hierarchical conception, which ultimately viewed a tonal composition in terms of the extension and elaboration of the tonic chord, often detailed through many levels of structure. And these ideas found expression in his four-volume work *Neue musikalische Theorien und Phantasien*, published between 1906 and 1935. Also, *Fünf Urfurien-Tafeln (Five Graphic Music Analyses)*, published in 1932, contained striking graph/score illustrations of his analyses in a meta-notation which has proved influential amongst music theorists. Essentially, Schenker's thinking tended towards the traditional scale-based approach, much favored in southern Germany and Austria, where melodic/voice-leading features were generally given greater weight: he decried speculative theories involving acoustics and 'scientific' explanations of music. On the other hand, a criticism of Schenker's approach, frequently raised, is that of the degree of subjectivity and lack of rigor it involves: two equally 'schenkerian' analyses of the same piece, can prove to be very different in practice. Schenker himself sidestepped the point by declaring his technique an art, not a science. Notwithstanding, music scholars have attempted to improve the objectivity and extend the range of schenkerian techniques, and equally, have also found the theory's 'flexibility' often a positive benefit, rather than a failing. Indeed, the elegance with which schenkerian analysis can at times encapsulate a sophisticated and complex piece of music, logically, within a simple meta-phrase, is truly breathtaking. (In the introductions to Examples M and N, the use of mutable numbers in schenkerian analysis is discussed.) Schenker was conservative in outlook and found little to admire in the music of his own time. His approach to music was absolute, rather than relative: tonality in music implied immutable 'laws', 'forces' emanating from the arrangements of notes and chords, a language which the great masters of past generations had understood and utilised, but now appeared to be lost. Heinrich Schenker died on the 13th January, 1935. As the dark clouds of war and unspeakable atrocity descended, two of his closest collaborators Oswald Jonas and Felix Salzer escaped to America.

Overall, by the end of the nineteenth century, after more than 300 years of growth, the tonal language of mutable numbers had reached a fullsome maturity. All the workable chord progressions, both from around the core dominant-tonic exchange, and the less powerful peripheral chordal and key progressions and successions, had been thoroughly exploited. Given that the western tradition is a written one, with a highly developed notational system, the possibility of simply cycling around forgotten older styles as a solution to the problem of what to do next, rather in the way the fashion industry produces an unending succession of 'new' styles inspired by previous eras, was not viable – as unlike clothes, the works of the historic masters don't wear out and get thrown away. Essentially, the historic canon and the vast bulk of popular music fall into the same broad category of *classic tonal music*. Most high art composers in the twentieth century (as opposed to those writing in more popular genres) were not content with 'classic' tonal expression and felt the need to produce something more 'radical'. Most of the art music of the twentieth century falls into this category, *radical tonal music*.

During the twentieth century, the more traditionally minded (often nationalist) composers writing radical tonal music, e.g. Bela Bartok (1881–1945), Charles Ives (1874–1954), Ralph Vaughan Williams (1872–1958), Jean Sibelius (1865–1957), Dmitri Shostakovich (1906–1975), tended to 'look through' the window of tonal computation to earlier epochs or peripheral genres, finding inspiration in pre-tonal modal styles, folk music and, in particular, the landscapes and character of their national homelands. Others took inspiration from exotic music cultures or ideas from other branches of the arts. For example, the 'impressionistic' style adopted by Claude-Achille Debussy (1862–1918) was influenced by the music of South East Asia, as well as the great school of French painting of the time. Also a significant group

experimented with a variety of different avenues: Kurt Weill (1900–1950), Sergei Prokofiev (1891–1953), Igor Stravinsky (1882–1971), Paul Hindemith (1895–1963), for example. Many were influenced by jazz. All these various approaches essentially continued using the underlying computational system of tonality, to a greater or lesser degree (while generally avoiding the overt use of anything too closely resembling the harmonic practice of previous generations) with additional elements taken from their chosen source mixed in to leaven the offering. One might say that they were living of the combination of ‘residual heat’ left behind after the tonal fire had burnt itself out, while bringing other non-tonal material to lay amongst the embers. Similarly, the various strands of jazz have woven elements taken from the livelier rhythmic traditions of Africa into what is basically a tonal fabric – though often using progressions of a somewhat opaque character, thereby facilitating the free flow of improvisation. Meanwhile, in the western popular genres, the language of mutable numbers rages on entirely unabated, seemingly able to recycle classic tonality endlessly, aided perhaps by the limited shelf-life of the majority of its products. Amongst the base load, there are of course many gems to be found, and, like so much twentieth century music, the influence of jazz is pervasive.

Other more revolutionary-minded composers of the twentieth century chose to reject the established language and start afresh: Arnold Schoenberg (1874–1951), Alban Berg (1885–1935), Anton von Webern (1883–1945), Pierre Boulez (b.1925) Karlheinz Stockhausen (b.1928), John Cage (b.1912), etc. However, the language of tonal computation has proved to be almost completely impervious to all attempts to shift to a new paradigm. So far, every attempt at forging a new language appears to have failed to reach, let alone engage, a wide audience. Perhaps there are no viable new (artificial) languages comparable to the one that nature has provided in the form of tonal computation – mutable numbers expressed in sound. At the beginning of the twenty-first century, there are some signs of an acceptance of this, with a discernible movement among composers back to the language of tonality as the foundation for coherent communication in western music.

From the standpoint of the tonal approach taken by the MOS model, atonal music can be accommodated within its framework as the ‘limit’ of tonality: the point at which every chord is described by a single ‘prime state’ harmonic series stretching up from a suitably chosen fundamental, without nesting. Most probably all these extended series would be beyond the ear’s tonal comprehension, as is intended. Indeed, from the tonal perspective of the model, all atonal compositions appear essentially the same, somewhat analogous to samples of a gas in equilibrium states of maximal entropy, where each example may be described by one piece of information, the temperature. Similarly, a single average measurement, of all the prime state mutable numbers found in an atonal composition, would be the extent of the MOS model’s penetration into this alien territory. Though any atonal composition would present a complex array of configurations, these would all go unnoticed from the MOS point of view as they contain little or no tonal information or structure – they have no accessible nested series for the processes of aural cognition to grasp and decipher. Though, of course, it must be emphasised that this is not to say that, taken on their own terms, these compositions are not highly structured works of art music.

Richard Franko Goldman 1910–1980, was born in New York, the son of the prominent bandmaster Edwin Franko Goldman, leader of the Goldman Concert Band. Goldman’s father was a gifted cornetist who had attended the National Conservatory and studied composition under Dvorak. Richard Goldman went to Columbia University where he studied music under the direction of Nadia Boulanger and Wallingford Riegger. From 1937 to the death of his father

in 1956 Goldman was assistant conductor of the Goldman Band, possibly providing the copious program notes which accompanied the summer concerts at Columbia and New York universities and in Central Park. During the years 1947 to 1960 R.F. Goldman was on the faculty of the Julliard School and in 1968 became director of the Peabody Institute in Baltimore. Richard F. Goldman was a prolific writer and music critic, from 1948 to 1968 served as New York critic for the *Musical Quarterly*, championing the works of Henry Cowell and Elliott Carter amongst others. In 1965 Goldman published his insightful book *Harmony in Western Music*. Significantly he was throughout his life closely involved with the 'nuts and bolts' of composition and the arranging of other composers' music, which perhaps (as with other music theorists) informed his intuitive grasp of the underlying processes and mechanisms of music, impelling his analysis unerringly toward the central logic of the tonal system. Richard Franko Goldman died on the 19th January 1980.

(Essentially, it was the collision of Goldman's analysis of tonal harmony read thirty-five years ago, with more recently acquired ideas derived from an interest in computer science which interacted and combined to form the basis upon which *Journey to the Heart of Music* is constructed. I offer my grateful thanks to the author.)

The twentieth century has seen music theory blossoming into a multi-faceted discipline with many influences coming from diverse fields, for example developments in psychology, analytical approaches in other branches of the arts and latterly perhaps, computers and computer science, plus recent progress made in the field of neuroscience. Also the development of a highly mathematical atonal theory based on the integer model of pitch, (i.e. the twelve tone chromatic scale modeled as the whole numbers 0 1 2 3 4 5 6 7 8 9 10 11) has developed into a significant area of study. This spreading of wings has to some extent come at the cost of a loss of focus on the central concern of previous centuries: *determining the fundamental nature of western music, as it exists*. Indeed, some might argue that today it is difficult to talk of 'western music' as a single entity, given the diversity of contemporary genres which abound. I would disagree: one single genre dominates overwhelmingly, that of tonal music in all its many incarnations – art music both old and new, popular music, jazz, etc. The diversity of contemporary non-tonal genres perhaps should be considered a somewhat more peripheral phenomenon, when viewed from the perspective of the relatively small numbers of participants involved. And perhaps to some extent the emphasis placed on the integer model in atonal theory has tended to direct attention toward the study of the twelve-note scale as the fundamental 'object' in western music and away from Rameau's conviction, that for tonal music, the fundamental object is the *corps sonore* – the harmonic series of oscillations of a sounding body. Ultimately music theory's principal aim must be to understand and explain the nature of music as it is. On any reasonable measure, that places tonally organised music at the head of the queue. However, notwithstanding tonal music's premier position, it should always be borne in mind that out of all the lands which constitute the continent of sonic art, many perhaps as yet undiscovered, the principality of tonal music occupies but a tiny part. For atonal music the integer model is a sensible choice which has yielded many deep and valuable insights, but for the study of the predominant mode of musical expression and communication in western culture, the harmonic series probably provides a more apt foundation. Ideally, the two approaches should be linked (i.e. the mathematics of Fourier analysis and set/group theory) so that each may contribute to a greater whole. One possible way of achieving this union is outlined in Chapter 9, Figure 9.20, where a dynamic MOS system naturally generates the twelve-note scale though a repeated nested sequence, impelled by the Second Law.

As to the long-running mystery of the minor chord, music theorists in the twentieth century were so busy with their many new concerns, that rather less attention was devoted to the problem. Now, in the twenty-first century, though of course it is for others to judge, it is my hope that the ideas presented in this

book might prove useful in tracking down the long-searched-for key to the paradox of the minor triad.

In the late Renaissance Zarlino approached music theory from a leading position within the central core of the western intellectual tradition. By the time of Rameau, in the eighteenth century, the scientific revolution had left music theory in its wake, and he was forced to import scientific techniques and methods to accomplish his work. The great strides taken in the nineteenth century were to be made by musically literate men of science: Helmholtz and Oettingen. In the twentieth century the separation had become practically total, with music theory ceding what had once been its central ground to the science of acoustics. Ironically, this loss occurred just as science was beginning to discover the quantum world of whole-numbered relationships so redolent of the bedrock of harmonic theory. Is it too much to imagine that one day, music theory might recapture a little territory, with music theorists perhaps even making something of a common cause with mathematicians and scientists, and in so doing, return the discipline to the position it once held in Zarlino's day, at the vanguard of human knowledge and understanding?

[6/10/09]

Notes

1. Grout, D.J., *A History of Western Music*, (J.M. Dent, London, 1962) p.68 & p.154
2. Tyson, A., (Ed), *Selected Letters of Beethoven*, (Macmillan, London, 1967).
3. Helmholtz, H. von, *On the Sensations of Tone...*, (4th Edn, Vieweg, Brunswick, 1877; Eng Tr. Ellis, A.J., 1885; Dover, New York, 1954).
4. Oettingen, A. von, *Das duale Harmoniesystem*, (Linnemann, Leipzig 1913).
5. Hauptmann, M., *Die Natur der Harmonik und der Metrik zur Theorie der Musik*, (Leipzig 1853; 2nd Edn 1873; Eng. trans. 1888).