Hugo Riemann and the Birth of Modern Musical Thought

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Hugo Riemann's moonshine experiment

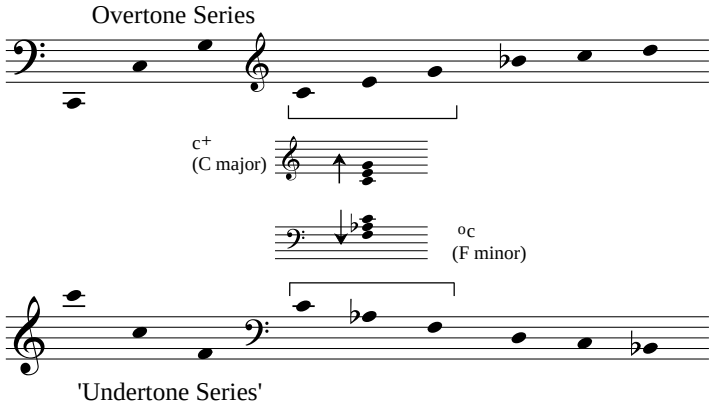
During a silent night in 1875, the young musicologist Hugo Riemann struck a key on his grand piano. He was listening for undertones, which he believed to exist in the sound wave.[1] His nocturnal experiment seemed successful – his aural experience confirmed his experimental hypothesis. These undertones, he would explain later, relate to one sounded tone exactly in the manner of the harmonic or overtone series but extending in the opposite direction. As Example 1.1 shows, where the overtone series extends above a given note (in this case, C two octaves below middle C), the undertone series extends below it (in this case, C two octaves above middle C), in the same integer ratios, to form its exact complement. In hearing these undertones, Riemann believed he had found the natural basis for the minor triad.

Since he discovered the works of the physicist-cum-music theorist Arthur von Oettingen in 1869, the young researcher had felt an affinity to the music-theoretical approach that became known as harmonic dualism, which explained the minor triad as the polar opposite of the major triad. Starting from the observation that both major and minor triads contain a perfect fifth and a major third, the dualists explained the major triad upwards from the bottom, and the minor down from the top. In this way, the minor triad is conceptualised as the exact inversion of the major. The F minor triad in Example 1.1 would therefore be named after its top note C; Riemann would call this triad 'under C', written ^{o}c.

Riemann's approach was more extreme than that of other dualists in that he built a complete musical system on the basis of the acoustical undertones that he had identified in his experiment. When Riemann's contention that the undertones are audible was not confirmed by others, he fiercely defended his position:

[1] The relevant entries from the *Musiklexikon* on the concept of 'undertone series' and other specific terms of Riemann's theoretical apparatus can be found in the glossary.

Example 1.1 Overtone and undertone series with pertinent triads: while the major triad is justified by the overtone series, the upside-down undertone series aims to legitimise the minor triad in equivalent terms.



However this may be, and if all the authorities in the world appeared and said: 'We cannot hear anything', I would still have to say: 'I can hear something, something very distinct.'[2]

Several authorities did in fact appear in due time and reported that they could not replicate Riemann's experiment. Employing a strategy familiar from debates in the natural sciences, Riemann countered by suggesting that the problem did not lie with the observation itself but merely with details in the experimental design.[3] For the precise replication of his experiment, he even recommended his brand of piano – made by Ernst Irmler.[4]

Riemann considered himself a serious natural scientist, or rather the founder of an empirical music aesthetics. By modern scientific standards, however, Riemann's experiment cannot be taken seriously on any account.[5] Dismissed as a scientific contribution, Riemann's moonshine experiment lives on as an anecdote, which has been told and retold

[2] Hugo Riemann, *Musikalische Syntaxis* (Leipzig: Breitkopf und Härtel, 1877; reprint Niederwalluf: Dr. Martin Sändig, 1971), p. 121. 'Wie dem auch sei und wenn alle Autoritäten der Welt auftreten und sagen "wir hören nichts", so muss ich ihnen doch sagen: "ich höre etwas und zwar etwas sehr deutliches".'

[3] This strategy is commonly found in post-Newtonian experimental science. The historian of science Simon Schaffer, for instance, explores how Newton's optical theory hinged on the make of the prism. See his 'Glass Works', in I. Bernhard Cohen and Richard S. Westfall, eds., *Newton: Texts, Backgrounds, Commentaries* (New York: Norton, 1995), pp. 202–17.

[4] Riemann, *Musikalische Syntaxis*, p. 121.

[5] The only sympathetic treatment of this episode can be found in Hans Peter Reinecke, 'Hugo Riemanns Beobachtung von "Divisionstönen" und die neueren Anschauungen

countless times in music theory classes. The almost endearing qualities of this old chestnut are punctuated by Riemann's scientific zeal to prove and defend what was evidently a lost cause. The moral of the anecdote in the music theory classroom is that today we know better: Riemann's observation of audible undertones has been refuted; acoustical undertones simply do not exist in the sound wave. Along with this scientific certainty, Riemann's harmonic dualism is completely discredited in current thought.

However, it is easy to forget that outside the theory classroom the anecdote has a different ending: Riemann's theory of harmony, which, as he insisted, was founded on this notion of harmonic dualism, went on to be the institutionally accepted doctrine in German musicology well into the twentieth century. His theory of harmonic function was an international success, and was translated into several European languages within a decade of its inception: his chief harmony tutor, *Vereinfachte Harmonielehre* (*Harmony Simplified*) of 1893, which went into its second edition in 1903, was also issued in English (1896), Russian (1896, second edition 1901), and French (1899); the third edition of his *Handbuch der Harmonielehre* (*Handbook of Harmony*) of 1898 was translated into French (1902) and Italian (1906). It would seem surprising – if not indeed a glaring paradox of history – that in spite of this evidently false notion of harmonic dualism, which he asserted was at the heart of his writings on harmony, Riemann was to become the most important German musicologist of his age.

It almost seems as if the initial anecdote, which continues to haunt the history of music theory, resonates with a sense of embarrassment that the establishment could be deceived so fundamentally. The image of Riemann hearing undertones has become a derisory emblem of theoretical hermeticism, coupled with a level of wrong-headedness that is so much beyond our comprehension that ridiculing the approach seems to be the only way to cope with the sheer absurdity of the concept of harmonic dualism. As one twentieth-century commentator puts it: 'One turns a man on his head and out comes a woman – *voilà*!'[6]

This said, it would be wrong to believe that critical voices did not exist during Riemann's lifetime. Witness the following criticism dating

zur Tonhöhenwahrnehmung', in Wilfried Brennecke and Hans Haase, eds., *Hans Albrecht in Memoriam* (Kassel: Bärenreiter, 1962), pp. 232–41. Reinecke points out that what Riemann believed to be undertones were in fact combination tones, but concedes – as a consolation prize, as it were – that Riemann's ability to hear these with the 'naked ear' means that his perceptive powers must have been extraordinary.

[6] R. Stein, cited in Martin Vogel, 'Arthur v. Oettingen und der harmonische Dualismus', in *Beiträge zur Musiktheorie des neunzehnten Jahrhunderts*, ed. Martin Vogel (Regensburg: Gustav Bosse, 1966), p. 132. 'Man stelle einen Mann auf den Kopf, so ist es ein Weib. Voilà.'

from 1878, the year after the publication of Riemann's first treatise on harmony, *Musikalische Syntaxis*:

> One is trying to force Nature to sound undertones, which cannot exist according to the laws of mechanics, and the most recent dualist Dr Hugo Riemann tells us that he and nobody else, save perhaps for Aristotle two thousand years ago, has heard these undertones, which alone are supposed to explain the consonance of the minor triad.[7]

Comments such as this one correspond to the currently prevalent view of harmonic dualism and testify that even in Riemann's own time, the dualistic approach was not without problems.[8] However, we must take care not to overemphasise the significance of such statements: they would seem to ring louder because we believe we can hear the voice of truth in them. Or, to put it in historical terms, their argumentative strength is only validated retrospectively, from our present position. We are far more susceptible to voices rejecting harmonic dualism than those upholding it because they reconfirm what we ourselves believe or would like to hear. The balance is tilted against dualism. However, as Riemann's stature in nineteenth-century musicology suggests, his own age judged differently.[9] In the same spirit, one reads again and again statements such as this one by a reviewer who wrote in 1896: 'One must be interested in what he writes, whether one agrees with his views or not.'[10] In other words, Riemann had become a musicological institution.

This is where our investigation begins. We should ask in this 'archaeological dig' how harmonic dualism became possible, and what

[7] Karl von Schafhäutl, 'Moll und Dur', in *Allgemeine Musikalische Zeitung* 13 (1878), col. 90. 'Man [d.i. die Dualisten] will die Natur dazu zwingen, Untertöne hören zu lassen, die nach mechanischen Gesetzen nicht existiren können, und der neueste Dualist Dr Hugo Riemann erzählt uns, dass er und sonst Niemand, als vielleicht Aristoteles allein vor 2000 Jahren, diese Untertöne, welche allein die Mollconsonanz erklären können, gehört habe.' (Schafhäutl is here referring to the concluding remark in Riemann's *Musikalische Syntaxis*.)

[8] A case in point would be Georg Capellen, who attacked Riemann's harmonic dualism in an extended, highly polemical, serialised article, 'Die Unmöglichkeit und Überflüssigkeit der dualistischen Molltheorie Riemann's', *Neue Zeitschrift für Musik* 68 (1901), pp. 529–31, 541–3, 553–5, 569–72, 585–7, 601–3, 617–19. Riemann's riposte, 'Das Problem des harmonischen Dualismus', published in the same journal four years later, makes reference to Capellen, but carefully avoids all mention of the article. This tactic of silencing one's opponents by ignoring them can also be observed in a similar polemic with Bernhard Ziehn. See Michael Arntz, *Hugo Riemann (1849–1919): Leben, Werk und Wirkung* (Cologne: Concerto-Verlag, 1999), pp. 260–5.

[9] Arntz, *Hugo Riemann*, pp. 179–300, examines the gradual establishment of Riemann's writings in the German institutions in some detail.

[10] Otto Taubmann, review of Riemann's *Präludien und Studien*, *Allgemeine Musikzeitung* 23 (1896), pp. 671–2. See also Arntz, *Hugo Riemann*, p. 268.

brought it to the fore, by considering the factors that lent the idea appeal and persuasive power. The guiding questions can be formulated quite simply: how could the concept of harmonic dualism, which seems so patently wrong to us, have been patently right in the later nineteenth century? What made this ostensibly absurd idea so convincing in Riemann's own age?

One post-war musicologist, Martin Vogel, has attempted an explanation by suggesting that all 'monists' of the period – that is, music theorists who explained major and minor triads in the conventional way, bottom-up – were intellectual lightweights.[11] However, the idea that dualism came to the fore by default, so to speak, confuses cause and effect: even if the matter could be solved by simple reference to the intellectual prowess of the individual theorists, it would still beg the question of why the more intelligent theorists at the time all favoured harmonic dualism. This question, inevitably, moves the argument away from individual minds, and towards the modalities of the discourse about harmonic dualism. On this level of enquiry, questions of legitimation and institutional authority come to the fore. For while the objections to harmonic dualism during Riemann's lifetime were in principle as obvious as they are now, his own high-ranking position within the musicological establishment suggests that the discursively encoded epistemologies at the time favoured the idea of harmonic dualism. The central question must therefore be: what institutional factors privileged the dualistic approach in nineteenth-century Germany? What was it that put harmonic dualism 'in the right'?

I

In the mid-nineteenth century, at the beginning of Riemann's career, the question of what music theory had to do to be 'in the right' was quite easy to answer: it had to be scientific.[12] Riemann clearly recognised this need: not only can we gauge this by his experiment where he claimed to be able to hear the undertones, but also because he was explicit about the need to establish music theory on a scientific basis. In a letter Riemann wrote to the idol of his youth, Franz Liszt, in 1879, he expressed his creed:

[11] Vogel, 'Arthur v. Oettingen und der harmonische Dualismus', p. 131.

[12] David Cahan, 'Helmholtz and the Civilizing Power of Science', in *Hermann von Helmholtz and the Foundations of Nineteenth-Century Science* (Berkeley and Los Angeles: University of California Press, 1993), p. 582. I also take the expression 'in the right' from there, although the more Foucauldian sense in which I use it here takes its cue from Georges Canguilhem.

Music theory belongs among the natural sciences, in the sense that art is nature; music theory would have a right to exist even if it only fulfilled the single purpose of proving the immanent law-abiding order of artistic creation.[13]

Riemann's aesthetic views might raise some eyebrows in this unreflected equation of art and nature. However, such scientific approaches to aesthetics and mimesis were in no way out of line with the general trends of later nineteenth-century aesthetic thought.[14] In particular, Theodor Fechner's psycho-physical aesthetics proved popular in the circles around Riemann – his work also provides the basis for the faith in the symmetrical principles on which harmonic dualism is based.[15] What is more, Riemann recognised that in order for music theory to be taken seriously, if it wanted to say anything authoritative about music at all, it had to partake of the prestige that the natural sciences enjoyed.

However, at the same time, the natural sciences were also at the core of Riemann's worry, for the 'immanent law-abiding order of artistic creation' that he found at the core of his enquiry had come under threat from precisely that direction. No less a figure than Hermann von Helmholtz, the most famous German physicist and physiologist of his time, had also written his own work of music theory – *Die Lehre von den Tonempfindungen* (*On the Sensations of Tone*) of 1863 – which approached harmony from the perspective of scientific principles. On the basis of physical measurements, taking into account acoustical phenomena such as the clashes between upper harmonics and the beatings of summation tones, Helmholtz had pronounced minor harmonies 'obscurely harmonious', 'ambiguous' and acoustically impure, and concluded that they must count as inferior to major harmonies.[16]

[13] La Mara (pseud. Maria Lipsius), *Briefe hervorragender Zeitgenossen an Franz Liszt* (Leipzig: Breitkopf und Härtel, 1904), vol. 3, p. 341. 'In diesem Sinne gehört die Musiktheorie unter die Naturwissenschaften, soweit nämlich die Kunst Natur ist; sie würde eine Existenzberechtigung haben, auch wenn sie nur den einen Zweck verfolgte, die immanente Gesetzmäßigkeit des künstlerischen Schaffens nachzuweisen.' See also Willibald Gurlitt, 'Hugo Riemann (1849–1919)' in *Veröffentlichungen der Akademie der Wissenschaften und der Literatur, Mainz: Abhandlungen der geistes- und sozialwissenschaftlichen Klasse* 25 (1950), p. 1875.

[14] See for instance, Paul Moos's retrospective survey of music aesthetics, first published in 1901, *Philosophie der Musik*, 2nd edn (reprint Hildesheim: Georg Olms, 1975), pp. 526–47, and Bojan Bujić, ed., *Music in European Thought 1851–1912* (Cambridge: Cambridge University Press, 1988), pp. 275–304.

[15] Gustav Theodor Fechner, Elemente der Psychophysik, 2 vols. (Leipzig: Breitkopf und Härtel, 1860), and *Vorschule der Aesthetik*, 2nd edn (Leipzig: Breitkopf und Härtel, 1897), pp. 62–5. On Fechner's psycho-physical parallelism, see Katherine Arens, *Structures of Knowing: Psychologies of the Nineteenth Century* (Dordrecht: Klüver, 1989), pp. 107–14.

[16] Hermann von Helmholtz, *On the Sensations of Tone*, trans. Alexander J. Ellis (London, 1885; reprint New York: Dover, 1954), pp. 299–300.

Helmholtz was by no means the first to declare the minor harmony a lesser or impure version of the major harmony, but because of his authority as a scientist of rank, his judgement appeared indisputable. He wrote:

> This assertion that the minor system is much less consistent than the major will be combated by many modern musicians, just as they have contested the assertion already made by me, and by other physicists before me, that minor triads are generally inferior in harmoniousness to major triads. There are many eager assurances of the contrary in recent books on the theory of harmony.[17]

Considering Helmholtz's work, in particular the last sentence quoted, we can begin to understand the dilemma of nineteenth-century music theory: the aesthetic postulate that major and minor should occupy an equivalent position in Western music is sharply contradicted by the experimental findings of the likes of Helmholtz. Helmholtz regretted this mismatch, but his scientific facts appeared unequivocal. In fact, he added a discussion reappraising the minor mode in light of its acoustical imperfections, which sounds somewhat like a consolation prize:

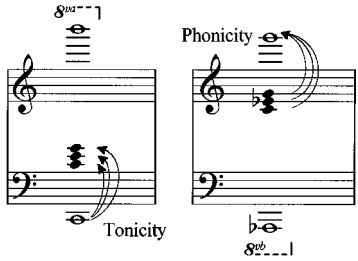
> But I am by no means of the opinion that this character depreciates the minor system. The major mode is . . . quite unsuited to indistinct, obscure, unformed frames of mind, or for the expression of the dismal, the dreary, the enigmatic, the mysterious, the rude, and whatever offends against artistic beauty; – and it is precisely for these that we require the minor mode, with its veiled harmoniousness, its changeable scale, its ready modulation, and less intelligible basis of construction. The major mode would be an unsuitable form for such purposes, and hence the minor mode has its own proper artistic justification as a separate system.[18]

But a 'justification as a separate system' is precisely what the minor mode did not obtain from Helmholtz. Just as the acoustical inferiority of the minor triad was explained – with a barrage of feminising adjectives – by its dependency on the acoustical *Klang* (sonority), which corresponds to the major triad, so the aesthetic effects of the minor mode, too, depend on what the major mode is capable of signifying. The minor mode is only of aesthetic use for that which is excluded by the major mode. Both acoustically and aesthetically, the minor system remains fundamentally no more than a failed major mode.

What is more, since the scientific prestige of Helmholtz's work automatically put him 'in the right', the only way to refute this judgement of science was to apply the same principles, to beat science with its own weapons. Riemann's experiment was designed to remedy this mismatch and to bring scientific observation in line with aesthetic postulates. To put it bluntly, if nature was not in a position to justify our aesthetic sense,

[17] Ibid., p. 301. [18] Ibid., p. 302.

Example 1.2 Oettingen explains his principles of tonicity and phonicity by means of overtones.



nature was wrong and had to be changed. Nature *ought* to work as music demands it, in order to satisfy Riemann's aesthetic requirements.

These aesthetic requirements were met by the idea of harmonic dualism, as it had been espoused by two other German nineteenth-century music theorists, Moritz Hauptmann and Arthur von Oettingen (who had in fact coined the term 'harmonic dualism').[19] However, both Hauptmann and Oettingen had taken a somewhat different approach from Riemann in the formulation of their theoretical ideas. To understand the considerable debate surrounding harmonic dualism, we have to examine briefly what those other theorists had to say on the matter of major and minor triads.

Oettingen, whose main field was physics, tackled Helmholtz head-on: he used the same kind of evidence, namely acoustical overtones, but drew radically different conclusions. He postulated corresponding degrees of chordal consonance for major and minor triads. Oettingen's argument was based on the observation, as the second part of Example 1.2 shows, that all three constituents of the minor triad did share certain overtones.[20] (Helmholtz had also noted this, but only in Oettingen's

[19] This story has been retold numerous times, beginning with Richard Münnich, 'Von [der] Entwicklung der Riemannschen Harmonielehre und ihrem Verhältnis zu Oettingen und Stumpf', in Carl Mennicke, ed., *Riemann-Festschrift* (Leipzig: Max Hesse, 1909), pp. 60–76. Modern discussions can be found in Suzannah Clark, 'From Nature to Logic in Schubert's Instrumental Music', PhD dissertation (Princeton University, 1997); Daniel Harrison, *Harmonic Function in Chromatic Music* (Chicago and London: University of Chicago Press, 1994); Dale A. Jorgenson, 'A Résumé of Harmonic Dualism', *Music and Letters* 44 (1963), pp. 31–42; Henry Klumpenhouwer, 'Dualistic Tonal Space and Transformation in Nineteenth-Century Musical Thought', in Thomas Christensen, ed., *The Cambridge History of Western Music Theory* (Cambridge: Cambridge University Press, 2002), pp. 456–76; David Kopp, 'A Comprehensive Theory of Chromatic Mediant Relations in Mid-Nineteenth-Century Music', PhD dissertation (Brandeis University, 1995), and William C. Mickelsen, *Hugo Riemann's Theory of Harmony and History of Music Theory, Book III* (Lincoln, Nebraska: University of Nebraska Press, 1977).

[20] Arthur von Oettingen, *Harmoniesystem in dualer Entwickelung* (Dorpat: W. Glässer, 1866), p. 32. This music example follows Harrison's very clear representation of Oettingen's

theory did this observation become an important point of his argument.) Oettingen went on to redefine the notion of consonance, declaring the minor triad consonant ('phonically consonant' – *phonisch konsonant* – as he called it) in so far as the lowest of these overtones corresponds harmonically to the sounding minor triad, in this example the G two octaves above.

On this basis, he then set out to reinterpret the major triad: as the first half of Example 1.2 shows, the three constituents of the major triad do also have an overtone in common. However, as it is not consonant with the triad itself, the major triad is defined as dissonant, at least according to Oettingen's 'phonic' criteria. Instead, the constituents of the major triad can in turn all be regarded as partials relating to one and the same fundamental, two octaves below the root – he therefore declared the major triad 'tonically consonant', or *tonisch konsonant*. An equivalent fundamental also exists in the minor example – in this case A♭. However, this fundamental is dissonant with the minor triad above it; the minor triad is therefore considered, correspondingly, to be 'tonically dissonant'.

The dissonant A♭ below the C minor triad corresponds inversely to the dissonant B above the C major triad, just as the C below the C major triad corresponds inversely to the G above the C minor triad. Based on the precise geometrical symmetry of these models, Oettingen concluded that major and minor triads are equivalent insofar as the major triad was phonically dissonant, but tonically consonant, while the minor triad was phonically consonant and tonically dissonant.[21]

Hauptmann, by contrast, whose work preceded that of Helmholtz by a decade, attempted to overcome the hurdle set by natural science by staying clear of argumentation along the lines of acoustics altogether. In the preface of his book *Die Natur der Harmonik und Metrik* (1853), he stated: 'Neither the truth nor the falsehood of the acoustical presuppositions has any further influence upon this theory itself; although in view of the untruth and half-truth of these presuppositions this can only redound to the advantage of the theory.'[22] Instead, Hauptmann sought to discover one single source, one natural principle, with which to explain harmony and metre in its entirety. For this reason, he turned to

principles; see Harrison, *Harmonic Function in Chromatic Music*, pp. 244–5. For a recent discussion of Oettingen's music-theoretical views, see Suzannah Clark, 'Seduced by Notation: Oettingen's Topography of the Major-minor System', in Suzannah Clark and Alexander Rehding, eds., *Music Theory and Natural Order from the Renaissance to the Early Twentieth Century* (Cambridge: Cambridge University Press, 2001), pp. 161–80.

[21] Oettingen, *Harmoniesystem in dualer Entwickelung*, p. 45.

[22] Moritz Hauptmann, *Die Natur der Harmonik und Metrik: Zur Theorie der Musik* (Leipzig: Breitkopf und Härtel, 1853); trans. and ed. William E. Heathcote as *The Nature of Harmony and Metre* (reprint New York: Da Capo Press, 1991), p. xxxviii (translation modified).

Example 1.3 Hauptmann's dialectical explanation of the major triad

(I) - **(III)**
C - e - G
(I) - **(II)**

constructing his theory on the basis of triples of dialectics and quasi-Hegelian idealism, which, for him, were 'second nature'.[23]

The major triad was for Hauptmann the embodiment of the three dialectical moments in the simultaneously sounding elements. Hauptmann postulated that there were only three 'directly intelligible intervals', the octave, the fifth and the (major) third.[24] All other intervals, he contended, were compounds of these three (the minor third, for instance, being the difference between the fifth and the major third). He represented the triad, in Example 1.3, as the product of these intervals in three dialectical steps: the octave (which here appears, at stage (I), as the unison) as the manifestation of unity and identity; the fifth (II), which Hauptmann heard with respect to (I) as a 'hollow' duality, and the synthetic third (III), which re-unites the opposed two components. At the same time, the double designation of (I) indicates that the principal tone of the chord, from which the intervals are reckoned up, is fixed in the pitch C.

Hauptmann regarded 'the minor triad as an inverted major triad',[25] and was quick to translate this symmetrical relationship into dialectical terms without much further explanation, as reproduced in Example 1.4a. In this form, which is the precise inversion of the dialectics of the major triad, the principal tone (C) is located in its fifth, as the double (I) underscores or, in his words, 'as Fifth determining Root and Third'.[26] Hauptmann did, however, present an alternative derivation of the minor triad in accordance with his later statement 'that all harmonic form shapes itself from below upwards',[27] which then, by necessity, results in something that is not the exact inversion of the major triad, as Example 1.4b shows. To preserve his initial axiom of the three directly intelligible intervals, Hauptmann had to assign a prominent role to the

[23] Hauptmann's theory is discussed in detail in Peter Rummenhöller, 'Moritz Hauptmann, der Begründer einer transzendental-dialektischen Musiktheorie', in Martin Vogel, ed., *Beiträge zur Musiktheorie im 19. Jahrhundert* (Regensburg: Gustav Bosse, 1966), pp. 11–36.

[24] Hauptmann, *Nature of Harmony and Metre*, p. 5. This is not the place to concern ourselves with the precise nature and validity of his arguments here, which would require a more detailed discussion of Hegelian and Fichtean dialectics in Germany. For detailed studies of Hauptmann see Peter Rummenhöller, *Moritz Hauptmann als Theoretiker: eine Studie zum erkenntniskritischen Theoriebegriff in der Musik* (Wiesbaden: Breitkopf und Härtel, 1963), and Dale A. Jorgenson, *Moritz Hauptmann of Leipzig* (Lewiston, NY: E. Mellen Press, 1986).

[25] Hauptmann, *Nature of Harmony and Metre*, p. 16.

[26] Ibid., p. 17. [27] Ibid., p. 102.

Example 1.4a Hauptmann's dialectical explanation of the minor triad as the inverse of the major triad.

(I) - **(II)**
F - a♭ - C
(I) - **(III)**

Example 1.4b Hauptmann's alternative explanation of the minor triad, bottom-up but no longer dialectical.

(I) - **(II)**
F - a♭ - C
(I) - **(III)**

major third between a♭ and C, whilst ignoring the minor third between F and a♭.[28] The emerging problem is obvious: how can one element of the triad, the C, represent two moments of the dialectic (II and III) at once? It is a dialectical impossibility to locate antithesis and synthesis in the same moment, as the former is supposed to be sublated by the latter. If the two are located in the same moment, the desired dialectical 'identity of identity and non-identity' is not attainable: the structure either becomes a simple contradiction or has had no true opposition in the first place.

Nevertheless, it was paramount for Hauptmann to present the minor triad theoretically as the opposition of the major triad; at the same time, however, he was at pains not to create the impression that the minor triad was actually generated downwards, as Riemann was to argue twenty years on.[29] To bolster the opposition between major and minor without suggesting that minor does in fact function top-down, Hauptmann introduced a metaphor, in which he tried to relate the character of the harmonic mode to its construction:

The minor triad thus being of passive nature, and having its starting-point above (not its most real starting-point, yet that which is determined as unity), and forming from it downwards, there is expressed in it, not upward driving force, but downward drawing weight, dependence in the literal, as well as in the figurative sense of the word. We therefore find in the minor chord the expression

[28] The use of small and capital letters, or of dashes above or below letters, in nineteenth-century German music theory signifies a tuning difference (usually of a syntonic comma). These slight differences play no part in this discussion here.

[29] In fact, Riemann regarded Hauptmann's theory as a major breakthrough in the formation of harmonic dualism. Brushing all of Hauptmann's qualms aside, Riemann confidently exclaimed in 'Die Natur der Harmonik', *Waldersees Sammlung musikalischer Vorträge* 4 (1882), p. 181, that Hauptmann's idea 'to regard the minor triad as a major triad put on its head, developed negatively', was 'sensational'. Later on, Riemann's enthusiasm for Hauptmann cooled down considerably; see Peter Rummenhöller, *Musiktheoretisches Denken im 19. Jahrhundert* (Regensburg: Gustav Bosse, 1967), p. 80, n. 11.

for mourning, the hanging boughs of the weeping willow as contrasted with the aspiring arbor vitae.[30]

The choice of metaphor can be read to reflect poignantly Hauptmann's problem: the boughs of the weeping willow hang down, while its root – biologically as well as musically – is still at the bottom, firmly attached to the soil. In the metaphorical realm, Hauptmann was in a position to solve the problem of the minor 'root'. (To be sure, the English term is more suggestive in this respect than its more perfunctory German equivalent, *Grundton*). At the same time, it can hardly be denied that Hauptmann was trying to square the circle. His weeping willow metaphor was consequently adopted happily by later dualists while the ironic ambiguity of the image became – literally and figuratively – uprooted.

II

Given this short overview of Riemann's immediate predecessors, to whose work he made reference repeatedly, it would seem that the contiguous relation between Hauptmann, Oettingen, and Riemann, and their involvement with the same problems, would make for a clear-cut group of nineteenth-century harmonic dualists. However, there is considerable disagreement as to who to count as a dualist – or, indeed, how to define harmonic dualism (which is often a function of the previous question).

There are usually two levels at which harmonic dualism is defined: first, in terms of the conceptual approach to harmony taken, that is, as the 'means of explaining the minor triad in a reverse sense from the explanation of the major triad'.[31] Under this definition, it becomes possible to count a wide range of thinkers as harmonic dualists, who had nothing directly to do with the circles around Riemann, even unlikely figures as Johann Wolfgang von Goethe. Goethe made his 'dualistic' point succinctly by means of a syllogism:

1. Musical practice recognises major and minor as equivalent.
2. The overtone series questions the equality of modes.
3. Therefore the overtone series is insufficient as an explanation for both modes.

[30] Hauptmann, *Nature of Harmony and Metre*, p. 17. In the original German this remarkable passage goes: 'In dieser passiven Natur und indem der Molldreiklang, zwar nicht seinen realen, aber seinen zur Einheit bestimmten Ausgangspunkt in der Höhe hat und sich an diesem nach der Tiefe bildet, ist in ihm nicht aufwärts treibende Kraft, sondern herabziehende Schwere, Abhängigkeit, im wörtlichen wie im figürlichen Sinne des Ausdruckes ausgesprochen. Wie in den sinkenden Zweigen der Trauerweide, gegen den strebenden Lebensbaum, finden wir darum auch im Mollaccorde den Ausdruck der Trauer wieder.'

[31] This definition is taken from Jorgenson, 'A Résumé of Harmonic Dualism', p. 31.

Goethe was quite content to conclude that 'Man *belongs* to Nature and he *is* Nature' and to leave the discussion at that.[32] However, in comparison with the approaches to dualism encountered previously, it is notable that Goethe made no attempt to give any detail as to the 'means of explaining' the two triads as opposites – in fact, unlike the circle around Riemann, Goethe's syllogism shows that he had no interest in acoustical arguments at all. At this level of definition, harmonic dualism is therefore perhaps better grasped in terms of the aesthetic postulate that the major and minor modes are equivalent and should consequently be treated as such by theory. The 'means' of explanation is thus better understood as the necessity to argue against the Helmholtzian paradigm, that the minor mode is not a derivative or an inflection of the major mode. As Goethe expressed in a bon mot, 'a Scandinavian theorist could say just as well that the major third was used in place of the minor'.[33] In other words, only if we presuppose the universal validity of acoustical measurements as the basis of musical consonance does it follow that the major triad is somehow 'natural' and less problematic than the minor.

While our first definition of harmonic dualism, on the basis of aesthetic desiderata, is wide-ranging, other critics have tried to define harmonic dualism on the level of methodology. In this second approach those aspects that distinguish the views held by thinkers such as Goethe from those of Riemann, as pointed out above, are considered crucial. In other words, the essence of harmonic dualism is here defined as positing a polarity between major and minor triads, and a methodology that orientates itself by the natural sciences.[34] As a consequence, the group of harmonic dualists becomes very small indeed – to the extent that, in the eyes of some critics, even Hauptmann cannot be counted as a proper harmonic dualist, and should thus not be grouped together with Riemann.[35]

[32] Jorgenson, 'A Résumé of Harmonic Dualism', p. 37. For recent commentaries on Goethe's views of music theory, see Dieter Borchmeyer, 'Anwalt der kleinen Terz: Goethe und die Musik', in Thomas Daniel Schlee, ed., *Beethoven, Goethe und Europa: Almanach zum Internationalen Beethovenfest Bonn 1999* (Laaber: Laaber-Verlag, 1999), pp. 41–62; and Thomas Daniel Schlee, 'Zelter hatte doch recht: Parerga zur großen Terz', in ibid., pp. 63–8.

[33] Jorgenson, 'A Résumé of Harmonic Dualism', p. 37.

[34] This definition is put forward, for instance, by Peter Rummenhöller. See his 'Moritz Hauptmann, der Begründer einer transzendental-dialektischen Musiktheorie', pp. 28–31.

[35] It is obvious that such revisionist attempts often go hand in hand with the desire to cleanse particular theorists from the taint of harmonic dualism and rehabilitate them as serious theorists. See Rummenhöller, 'Moritz Hauptmann, der Begründer einer transzendental-dialektischen Musiktheorie'. In a similar vein, Martin Vogel has attempted to separate Oettingen from Riemann, see 'Arthur v. Oettingen und der harmonische Dualismus', p. 107.

It is, however, possible to arrive at a definition of harmonic dualism from a third perspective, which combines aspects from both definitions and links them on the basis of a historical argument. As we have seen above, harmonic dualism, taken at its basic level, is the postulate of theoretical equivalence between the major and minor systems. There is little controversy about this point. Rather, the controversy of harmonic dualism is concerned with its attempt to explain and ground this equivalence. The 'means' that was underlined in the first definition of harmonic dualism becomes crucial with respect to this controversy: it was apparently no problem for a theorist such as Goethe, or the sixteenth-century Gioseffo Zarlino – whom Riemann regarded as the founder of the dualistic tradition – to argue for an equivalent formation of the minor triad. It seems that it is only in the aftermath of Riemann's experiment that harmonic dualism became a problem.

If this is so, one must ask whether it is indeed possible to speak of a dualistic tradition extending further back than the mid-nineteenth century, as the proponents of the first definition – and Riemann himself – would do. As a prominent twentieth-century critic, Carl Dahlhaus implicitly turns to this issue when he devotes an article to the question 'Was Zarlino a dualist?' – and, predictably perhaps, answers it in the negative.[36] Dahlhaus shows how Riemann mistranslated and quoted out of context in order to make Zarlino's theory fit his own ideas and in this way to fashion him into an early proponent of harmonic dualism. However, Dahlhaus goes too far in his zeal to exorcise Zarlino from Riemann's dualistic spell.[37] Although it is true that Zarlino had not read minor triads top-down the way Riemann did, he nevertheless considered the relationship between the two formations that came to be called 'minor and major triads' as symmetrically related:

> While the extremes of the fifth are invariable and always in the same ratio . . . the extremes of the thirds are placed differently within the fifth. I do not mean that such thirds differ in proportion but in location. For . . . when the major third is below, the harmony is gay, and when it is above, the harmony is sad.[38]

[36] Carl Dahlhaus, 'War Zarlino Dualist?', *Die Musikforschung* 10 (1957), pp. 286–90.

[37] Dahlhaus's argument rests on the mathematical basis of Zarlino's harmony, as a rational proportion of no musical or sensual impact, perhaps to counter Riemann's approach to the triad as a musical and conceptual entity. It is interesting to note, however, that in Chapter 31 Zarlino was discussing 'perfect proper harmony', which is defined in Part II, Chapter 12 as a perfect consonance mediated by an inner-part imperfect consonance. The terminology would seem to suggest that this 'perfect' three-part harmony is superior to the 'imperfect' two-part harmony, while the mathematical ratios, conversely, become more complex – or less 'perfect' – in three-part harmony.

[38] Gioseffo Zarlino, *Le istitutioni harmoniche* (Venice, 1573), p. 211; English trans. by Claude V. Palisca and Giulio A. Marco as *The Art of Counterpoint* (New Haven, Conn.: Yale University Press, 1968), pp. 69–70. 'Ma perche gli estremi della Quinta sono invariabili

Ironically, this statement describes precisely the way in which Dahlhaus explains harmonic dualism, namely that 'in major the major third is incorporated at the bottom, in minor at the top, into the fifth'.[39] Dahlhaus argues, however, that Zarlino's last sentence in the above excerpt, on which Riemann's appropriation of Zarlino as a dualist hinges, is of no theoretical consequence. What Zarlino meant to say, Dahlhaus infers, was rather that it is 'not the different positions of the *major* third [that] effects the character difference of the triads, but the difference of the *bottom* third (major or minor)'.[40] However, this 'monistic' reading of Zarlino is clearly as tendentious as Riemann's, for Zarlino did not in fact single out the *bottom* interval at all in this context.[41]

A musical example from Zarlino's *Istitutioni harmoniche*, although it appears in a context unrelated to this particular argument, illustrates how his point might be better understood. Zarlino includes a canon in his work, realised in Example 1.5, which alternates major and minor triads at the beginning of every odd-numbered bar.[42] The polyphonic texture makes it obvious that neither Riemann's dualism, conceptualising minor triads from top to bottom, nor Dahlhaus's 'monism', conceptualising minor triads from bottom to top, are appropriate readings of Zarlino. As Zarlino described above, here it is indeed the position of the major third – to which the minor third is added above or below – that makes all the difference. There are, in other words, viable alternatives to

& sempre si pongono contenuti sotto una istessa proportione . . . però gli estremi delle Terze si pongono differenti tra essa Quinta. Non dico però differenti di proportione; ma dico differe[n]ti di luogo; percioche . . . qua[n]do si pone la Terza maggiore nella parte grave, l'Harmonia si fà allegra; *&* qua[n]do si pone nell'acuto si fà mesta.' Daniel Harrison, too, re-examines Zarlino's alleged dualism in *Harmonic Function in Chromatic Music*, pp. 259–61, and notes that there is one correspondence with Riemann, namely the importance given to the interval of the major third while the minor third is not mentioned as a constituting factor in the minor harmony. Riemann used this quotation in his *Geschichte der Musiktheorie*, 2nd edn (Berlin: Max Hesse, 1921; reprint Hildesheim: Olms, 1990), p. 393.

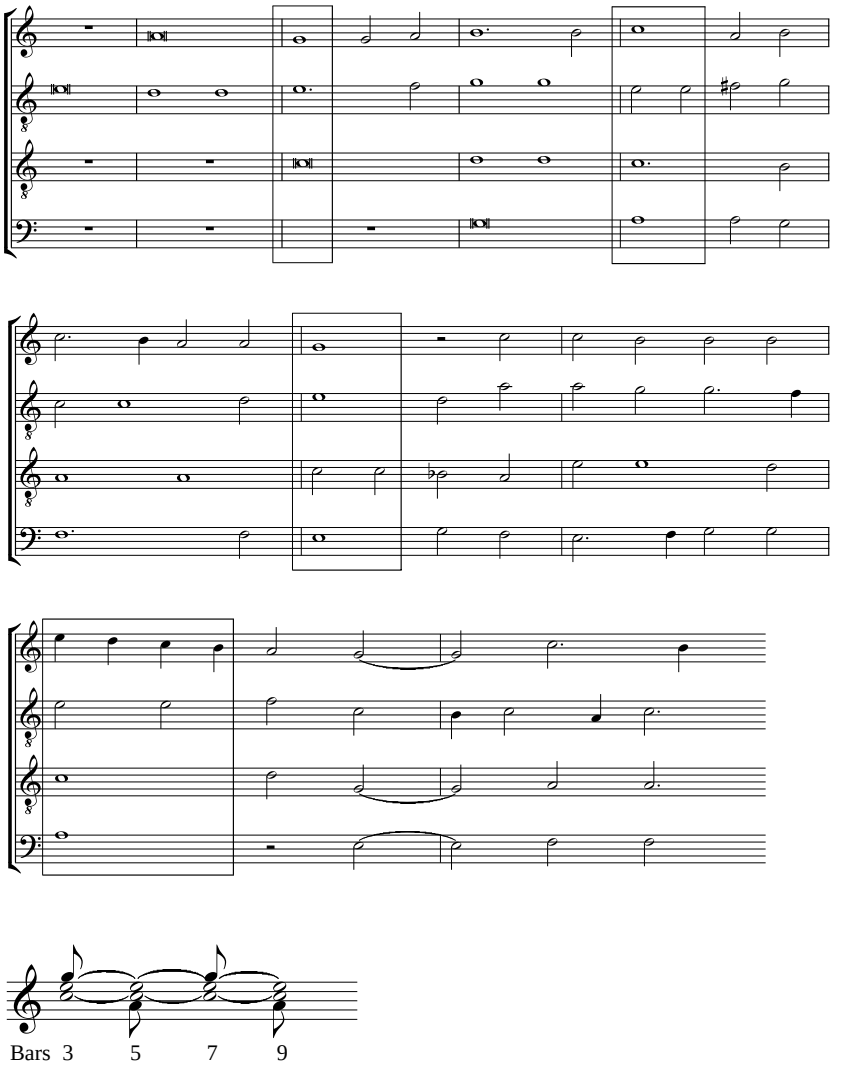
[39] Dahlhaus, 'War Zarlino Dualist?', p. 287. The rest of Dahlhaus's definition, strangely, refers to Oettingen's dualism, not to Riemann's.

[40] Ibid., p. 290. Emphasis in original.

[41] What Zarlino in fact wrote is more ambiguous: 'Whereas in the first group the major third is often placed beneath the minor, in the second the opposite is true' (*Art of Counterpoint*, p. 21). To be accurate, Zarlino drew on at least three ways of explaining major and minor formations. Besides the one quoted above, he argued that the major third and major sixth are 'lively and cheerful' intervals, while the minor third and minor sixth 'although sweet and smooth, tend to be sad and languid' (p. 21). Further, the major mode is divided harmonically, according to string divisions, while the minor mode is arithmetically divided, the consonances are arranged 'contrary to the nature of the sonorous number' (p. 22).

[42] I first found this canon mentioned in Alan Gosman's 'Rameau and Zarlino: Polemics in the *Traité de l'harmonie*', *Music Theory Spectrum* 22 (2000), pp. 46–7, where it appears in a different context.

Example 1.5 Zarlino's double canon *per inversionem*, from *Istitutioni harmoniche*, vol. 3. The boxes highlight the alternation of the minor third above or below the major third.



Riemann's dualism and Dahlhaus's monism. The implicit assumption on both Riemann's and Dahlhaus's parts, that Zarlino must be either a dualist or a monist, is pure music-theoretical ideology.

In this sense, the very question of whether Zarlino – or any other pre-nineteenth-century music theorist, for that matter – was a dualist actually misses the point. It is, as the sociologist Ernest Gellner

knew, perhaps the one established law in the History of Ideas that 'whatever has been said, has also been said by someone else on an earlier occasion'.[43] So the reply to Dahlhaus's question should be: Zarlino's music theory may indeed have adumbrated some features that became important to Riemann later.[44] Given that all ideas 'are in effect ever-present' – following Gellner's law – the central question is not how Zarlino's theory pre-empted Riemann's but rather how the concept of harmonic dualism should have become a powerful and convincing approach in the nineteenth century.

Nineteenth-century harmonic dualism, then, is qualitatively different from any other outlook on music that seeks to present the minor system as equivalent to the major system: it only became a problematic concept in a particular cultural, intellectual and social constellation. From now on we shall only speak of harmonic dualism with reference to its nineteenth-century proponents. With the exception of Vincent d'Indy (who has occasionally been accused of simply copying Riemann's ideas), this group is exclusively German. Harmonic dualism is marked by self-awareness and by a special effort to find an invincible epistemology. It is no coincidence that the term should have been coined in the nineteenth century, for the very idea of dualism only makes sense in the context of its counterpart, the views of acousticians of Helmholtz's calibre.[45] Prior to this view of music, and the conflicts arising from it, there was no need for a separate tradition of music theory. Harmonic dualism, we could redefine, is the attempt to declare the major and minor modes as natural, in conflict with the scientifically accepted concept of nature at the time. In other words, the problems of dualism lay outside the musicological discourse; they were caused by the standards set by natural science, to which music theory aspired, as Riemann explained in his letter to Liszt quoted above. We can now see from this angle that Hauptmann, who so ferociously reacted against arguments that draw on physical acoustics, was no exception from this: he was by the same token deeply entangled in the debate.

III

What has changed since the nineteenth century? Why did harmonic dualism go out of fashion in the early twentieth century, and become considered 'wrong'? In principle, nothing has changed regarding the gap between aesthetic desiderata and acoustical data. And yet, hardly

[43] Ernest Gellner, *Relativism and the Social Sciences* (Cambridge: Cambridge University Press, 1985), p. 9.

[44] See Daniel Harrison, *Harmonic Function in Chromatic Music*, pp. 259–61.

[45] To my knowledge, the sole notable exception to this is Rameau's treatise *Génération harmonique* (Paris, 1737), which will be discussed in Chapter 3.

any living theorist would consider harmonic dualism a viable solution to this problem. The difference is simply that while for Riemann the issue of closing this gap was at the very heart of his music-theoretical endeavour, we have become used to ignoring the problem. While the clashes between overtones and beatings of summation tones are still the same as in Helmholtz's day, we have taken the other avenue, and – with few exceptions[46] – tend to disregard acoustical science altogether when talking about major and minor harmonies. With this music-theoretical paradigm shift, however, harmonic dualism became redundant; it became an attempt to answer a question that no longer interests us.

The conclusion that harmonic dualism is historically redundant is markedly different from the initial derisory anecdote of Riemann's moonshine experiment, which held that his failed undertone hypothesis rendered the whole dualistic view untenable. Of course, the aural observations Riemann made during that fateful night were undeniably false, but to what extent does this circumstance actually invalidate his theoretical claims? Given that acoustical data are of virtually no importance to tonal theory in the current age, it would seem strange to dismiss one music theory on the basis of criteria that are not applied to others. (The twentieth-century adaptations of Riemann's theory of harmonic function, most of which operate without the acoustical underlay of dualism, seem to confirm that this is a distinct possibility.[47])

Contrariwise, it might be objected that Riemann brought all this upon himself in this silent night, by setting such 'scientific' standards for himself in the first place. However, at the risk of spoiling the anecdote once and for all by dissecting the punchline in even greater detail, the joke – and along with it the notion of the 'wrongness' of Riemann's theory – thrives on a peculiar twist in the paradigm shift. For while musicology, or rather its epistemological aspect, has moved away from a paradigm based on acoustical science, the acquisition of knowledge in most other areas of society has remained firmly anchored in an unwavering faith in science. It is this double-layered epistemology that makes the joke of the Riemann anecdote and, crucially, stops us from contemplating the issues any further. Once we start rethinking it, however, the certainty with which harmonic dualism is habitually rejected as absolutely 'wrong' would have to give way to a more considered verdict.

What the anecdote does not betray (as it would certainly spoil the punchline) is that Riemann's claim that undertones were audible was

[46] Martin Vogel is perhaps the only twentieth-century theorist who proposes an acoustically based kind of harmonic dualism on the basis of Oettingen's theory.

[47] For a survey and study of these post-Riemannian systems of harmonic function, see Renate Imig, *Systeme der Funktionsbezeichnung seit Hugo Riemann* (Düsseldorf: Verlag der Gesellschaft zur Förderung der systematischen Musikwissenschaft, 1971).

only one stage in a number of different attempts to find a foundation in which to ground his dualistic ideas. The precise nature of Riemann's harmonic dualism (and the undertone series) changed throughout his career and was redefined no fewer than four times. First he posited – as a 'small hypothesis' at the outset of his doctoral dissertation – that undertones are generated in the ear, that is to say that the cilia on the basilar membrane swing in places corresponding to simple fractions of the sounding tone which are picked up by auditory nerves.[48] This audacious assertion did not fare well: Riemann's thesis was rejected at the University of Leipzig – the 'small hypothesis' was perhaps a big stumbling block for its acceptance. At the same time, it was probably no great coincidence that Göttingen's famous philosopher Hermann Lotze accepted his thesis. In the commentary on Riemann's dissertation Lotze remarked with good humour:

> It is a pity that he (Riemann) has the same trust not only in the pretty experiments of the natural scientist (Helmholtz) but also in the latter's audacious conjectures and his arbitrary psychological assumptions. The actual psychological element of his work is therefore least satisfactory and independent. He even makes rather wasteful use of 'brain oscillations'.[49]

Although Lotze remained sceptical of Riemann's explanations (it would appear from his comments that he did not believe a word of it), he nonetheless let his student pass. For it seems that Riemann's dualistic arguments did strike a sympathetic chord with Lotze in spite of their highly speculative nature. As I shall examine in greater detail in Chapter 3, it was perfectly possible in Lotze's philosophy to build on phenomena that 'ought to' exist but did not.

Riemann's experiment at the grand piano falls into his second phase of harmonic dualism, where he relocated the undertones from the basilar membrane to the sound wave itself; he believed he could hear the undertones objectively.[50] Not dissimilarly from Rameau in *Génération*

[48] Riemann, *Über das musikalische Hören*, Dr. phil. dissertation (Göttingen University, 1873), publ. as *Musikalische Logik* (Leipzig: C. F. Kahnt, 1874), p. 6.

[49] Cited in Jacques Handschin, *Der Toncharakter*, intro. Rudolf Stephan (reprint Darmstadt: Wissenschaftliche Buchgesellschaft, 1995), p. 129. 'Zu bedauern ist einigermassen, dass er (Riemann) nicht nur den schönen Experimenten dieses Naturforschers (Helmholtz), sondern auch seinen kühnen Konjekturen und den willkürlichen psychologischen Annahmen desselben ganz gleiches Vertrauen schenkt; das eigentlich psychologische Element seiner Arbeit ist daher am wenigsten befriedigend und selbständig; wird doch sogar von Hirnschwingungen ziemlicher Verbrauch gemacht' (Additions in parentheses by Handschin). Also see Riemann, *Handbuch der Akustik (Musikwissenschaft)* 3rd edn (Berlin: Max Hesse, 1921), p. 93n.; and Gurlitt, 'Hugo Riemann (1849–1919)', pp. 1872–3.

[50] The article, 'Die objective Existenz der Untertöne in der Schallwelle', *Allgemeine deutsche Musikzeitung* 2 (1875), pp. 205–6, 213–15, has an intriguing reception history. The chief summaries of Riemann's works on harmony (by Elmar Seidel, William Mickelsen and Daniel Harrison) refer to it in passing; there is no indication, however, that Seidel has

harmonique a century and a half before him, Riemann believed that 'strings that are not stopped with a mute and which correspond to the undertones of a sounded tone not only vibrate in parts but also in total'.[51] Riemann brushed aside the objection that these total vibrations still remain inaudible simply by claiming that they were only very soft.

After 1891 Riemann changed his argument to a demonstration that the undertones were necessarily inaudible due to acoustical interference between sound waves.[52] This argument provided him with a comfortable position, since he could still claim the nominal existence of the undertones without having to prove their audibility. Finally, after 1905, Riemann agreed to do away with arguments based on undertones altogether, provided that overtones were not used either in the arguments of music theory.[53] With this last stage, where acoustical undertones were no longer necessary as a conceptual crutch,[54] Riemann's theory verged on a new paradigm: the age of psychology was about to supersede the age of acoustics.

IV

One of the puzzling consequences of the position of music theory in modernity – particularly the nineteenth century – is that whilst its principal function is bound up with the legitimacy of musical structures and works, it itself also requires legitimation for the principles it posits. It is notable that the most popular categories of legitimation are those that locate themselves outside the human element.[55] In this way, the limits that music theory imposes on music are alleged not to be capricious but

in fact consulted the article ('Die Harmonielehre Hugo Riemanns', p. 52n.). Mickelsen, *Hugo Riemann's Theory of Harmony and History of Music Theory, Book III* (Lincoln: Nebraska University Press, 1977), pp. 33–5, admits to not having read it but nevertheless proceeds to reconstruct its contents. Harrison, at the end of this line, then only refers to Mickelsen's hypothetical reconstruction, in *Harmonic Function in Chromatic Music*, p. 256.

[51] Riemann, *Musikalische Syntaxis*, p. xiii.

[52] Riemann, *Handbuch der Akustik*, pp. 78–81. See also Chapter 3 below.

[53] Riemann, 'Das Problem des Dualismus', p. 26. An earlier version of this psychology-based argument is presented in the article 'Die Natur der Harmonik'. A tentative step towards relinquishing arguments using undertones can be found in *Handbuch der Akustik*, pp. 93–6.

[54] Just to be sure, however, an explanation that made reference to the acoustical wave was retained by Riemann even in 'Das Problem des harmonischen Dualismus'. See Chapter 3, n. 105 below.

[55] For further information on this vast topic, see Nicholas Cook, 'Epistemologies of Music Theory', in Thomas Christensen, ed., *The Cambridge History of Western Music Theory* (Cambridge: Cambridge University Press, 2002), pp. 78–105; Suzannah Clark and Alexander Rehding, eds., *Music Theory and Natural Order from the Renaissance to the Early*

immutable and incorruptible – or, put more concretely, the limitations are presented as natural, rational or dictated by history. Music theory tries to anchor itself in the extra-musical in this way. Its claims of (and to) legitimacy are thus not perceived as arbitrary but as obeying a higher imperative.

It would be fallacious to assume that music theorists pick and mix these foundations at will. These constructs are not usually adopted self-consciously but are rather dictated by the epistemologies that are institutionally sanctioned at the time of their conception, and in this way they assign music a position within society. This approach questions not only what the legitimising categories of a music theory are but also how they are (re)constructed by the music theory under scrutiny and how they function within it. The questions asked are no longer: 'What does a given theory do, and is what it does correct?', but: 'Why does this theory want its users to think about tonal harmony in this way and not in any other way?'[56] As soon as we accept that the 'wrongness' of harmonic dualism is not an intrinsic quality of the theory but is brought about by a change of paradigm, these continual changes, the perpetual reformulation of the foundational elements of Riemann's theories, the undertone hypothesis can in fact be a very useful tool, aiding us in understanding what made Riemann's theories of harmony the success story that they were in the later nineteenth century.

If we now return from this new position to Riemann sitting at his grand piano that silent night in 1875, the moonshine experiment takes on a different significance. While Hauptmann and Oettingen may be seen to epitomise the two main strands of German *Wissenschaft* in the nineteenth century – the speculative philosopher in the shadow of Hegel on the one hand, and the rigorous natural scientist on the other – Riemann synthesised features from both of them. In this sense, when Riemann heard fictitious undertones ringing through the night, as we shall see over the next four chapters, what he was in fact doing was to accomplish the peculiar wedding of speculative philosophy and 'hard' natural science that characterised the epistemology of Wilhelmine Germany.

Twentieth Century (Cambridge: Cambridge University Press, 2001); Carl Dahlhaus, *Die Musiktheorie im 18. und 19. Jahrhundert; Erster Teil: Grundzüge einer Systematik* (Darmstadt: Wissenschaftliche Buchgesellschaft, 1984), pp. 34–63; and Rudolf Heinz, *Geschichtsbegriff und Wissenschaftscharakter in der Musikwissenschaft in der zweiten Hälfte des 19. Jahrhunderts* (Regensburg: Gustav Bosse, 1968).

[56] Scott Burnham poses related questions in 'Musical and Intellectual Values: Interpreting the History of Music Theory', *Current Musicology* 53 (1993), p. 79.