

THE CHANGING ROLES OF ACOUSTICS AND MATHEMATICS IN NINETEENTH-CENTURY MUSIC THEORY AND THEIR RELATION TO THE AESTHETICS OF AUTONOMY

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Introduction

Relations between aesthetic positions and concurrent ontologies can reveal significant cultural undercurrents within an historical period. The aim of this paper is to consider one of the many complex relations between European harmonic and compositional treatises of the eighteenth and nineteenth centuries and the development of the view that works of art are autonomous. More specifically, the aim is to argue that a certain philosophical orientation informed the changing role played by 'nature' in the explication of chord generation in these treatises, and that this orientation cannot be understood in isolation from changes in the concept of the musical work itself during the course of the two centuries. In broad terms, increasing resistance to explaining musical works in terms of 'extra-musical' mediums and functions is shown to run a parallel course with increasing resistance to 'extra-musical' explanations – in this case explanations in the form of string divisions, resonating bodies, etc. – for the generation of chords.¹

This parallel is not theoretically necessary; nor can it be mapped consistently throughout the century. To begin with, the way in which the musical work was thought to relate to 'nature' is fundamentally different from the way in which theories of chord generation were explained as being related to 'nature'. Two essentially different traditions are involved here – the tradition of art imitating nature, as in classical aesthetics, and the speculative tradition of deriving harmonic theory from string lengths or, later, the overtone series. The first tradition which is literary and philosophical entered the discipline of aesthetics in the first half of the eighteenth century. The second tradition is the Pythagorean, neo-Platonic ('harmony of the spheres') one, which has a long and much written-about history. The two traditions have no necessary correspondence with each other, and, as has been noted, the term 'nature' signifies differently in each case. However by unpacking the origins and historical significance of each tradition, the present argument will demonstrate a relation between the two traditions by tracking an underlying affinity between the aesthetic of autonomy and the ethos and methods of positivist empiricism.

The first section of the following discussion examines the rise of an aesthetic of autonomy towards the end of the eighteenth century and suggests some of the ways that theorizing about music was affected by this aesthetic. Instead of functioning as a musical 'type', the autonomous musical work functioned as a self-governing whole imbued with metaphysical significance. This changing conception situated the listening subject differently in relation to the work. In short, the autonomous work demanded active interpretation and, as a result, analysis, as a discipline, arose.

The second section tracks the changing role played by the observation of natural phenomena in theories of chord generation. Using John Neubauer's model of an emergent Pythagoreanism in the late eighteenth and the early nineteenth centuries, it will be shown that theories based in natural phenomena gradually lost their explanatory charge. The origin of chords and tones were now considered less as acoustical phenomena and more as metaphysical entities existing in internally regulated relations. This shift, it will be argued, was crucially implicated in the rise of the aesthetic of autonomy.

The third, and final, section considers the resurgence of interest in acoustics in the late nineteenth century in the light of this aesthetic. Far from understanding this renewed interest as an independent development, unaffected by the aesthetics of autonomy, I put forward a differently focused history of relations between 'science' and 'art' – a history which will suggest less a rift than a deep affinity between the two fields. The argument will not set up strands of causality that can be tested in any empirical sense, aiming rather to excavate some of the philosophical underpinnings informing both traditions. Analogies are thus to be understood as signs or symptoms that define a common ground during the period under discussion.

The Rise of Aesthetic Autonomy

Most recent theorists understand the nineteenth-century transition to conceiving of musical works as autonomous in terms of a break from some kind of extra-musical constraint. Thus, for Carl Dahlhaus music was emancipated as soon as it broke with imposed purposes and became functionless. For John Neubauer emancipation was signalled by a break from language. Instrumental music changed from what Johann Mattheson called a 'less complete (vollkommen) art' to a self-sufficient, autonomous art that in certain instances commanded more powerfully than language itself (Mattheson, quoted in Dahlhaus 1982: 25). It did this by freeing itself both from other mediums (such as language) and from circumscribed social functions (such as dance).

The gradual forging of an autonomous realm for the arts was given philosophical expression at the turn of the century by writers such as Immanuel Kant, Johann Gottfried Herder, August Wilhelm von Schlegel, Christian Friedrich Michaelis and Arthur Schopenhauer. In 1790 in his *Critique of Judgment*, Kant laid down the philosophical foundation for the liberation of art from social purpose. By identifying the philosophical conditioning for the lib- upon which judgments of taste are made, Kant posited a domain of fine art that was released from dependency upon concepts: he figured the artwork as a purely formal and self-sufficient entity. Concomitantly, he saw aesthetic contemplation as demanding a kind of sensory attention that was disinterested. What counted as aesthetically significant was the object in its pure form, stripped of any content or of any concept under which it could fall. In order to set forth the free-play (*Spiel*) of the faculties, the human subject needed to reflect on the formal presentation of the art object as such without the encumbrance of moral or epistemological considerations.

Kant did not view himself as constructing an empirical account concerning the nature of art in the world nor as elaborating upon the subjective experience of art. He rather attempted to demand by his philosophical scheme since it rejected both rationalist and empiricist claims about art.

On the one hand, Kant disengaged from the Cartesian rule-governed view of art, claiming instead that art was the product of inspired genius. Unconstrained by rules, the genius learned his art from exemplary works. He would not imitate (*Nachahmung*) these works so much as follow in their example (*Nachfolge*). Thus the artist-genius situated himself in a tradition of singular exemplars that could not share objective traits and then strove to create something different and original.

On the other hand, Kant distanced himself from the empiricist view that a standard of taste can be assumed to be evident merely because it can be observed that some works stand the test of time while others do not. In contrast, Kant aimed to give an objective account based on a subjective experience by describing the formal preconditions of the experience. He posited that conditioning moments, based on a faculty that was common to all human beings, were *a priori* universals and that they were not subject to empirical observation. Thus

Kant evacuated from his scheme both an empirical component and a rationalist emphasis on the rules of art; he offered instead a transcendental account whereby the explanation of aesthetic judgment depended upon seeking its prior conditions. By focusing the inquiry on irreducible prior conditions, Kant freed art from determination by rules and from the contingencies of mere taste. Aesthetic judgment thus happened free of anything that was identifiable, and art works themselves were understood to be free, self-sufficient and autonomous. It is risky to limit any reading of Kant to the above aspect alone, because he sees aesthetic freedom as serving to bring moral man (exercising practical reason) in contact with the scientific world (man exercising pure reason). Nonetheless his *Critique of Judgment* laid the foundations for the notion of aesthetic autonomy which profoundly impacted thought about music in the romantic age. To take a few examples: for Heinrich Wackenroder, music occupied an almost angelic domain that was independent of the actual world, for Schopenhauer, music inhabited a realm that was closely analogous to the strivings of the Will – precisely the domain that was free of the ordinary world of representation; and for Søren Kierkegaard, music exemplified the movements of the pure life force freed from the everyday. By the time Eddard Hanslick's *Vom Musikalisch-Schönen* was published in 1854, the expressly metaphysical aspect that secured the musical work's autonomy gradually receded, giving way to a purely formalist aesthetics. For Hanslick, 'sounding forms in motion are the sole and exclusive content and object of music.' While he did refer to the metaphysical significance of music 'in its reflection of the great laws of the world' (Hanslick, quoted in Bond 1997: 415), he omitted this reference from editions subsequent to the first. The musical work thus existed in an abstract realm of self-sufficient significance. The changes in the philosophical conception of music can be discerned in contemporaneous music theory and composition. Dahlhaus argues that the transition included changing the conception of musical composition from being a type of handicraft to being a form of art. The autonomous work – indeed the concept of the work – emerges precisely at this historical juncture² – is free of external goals and should thus not be constrained by rules of grammar.

Esthetics – the theory of works of art in the modern emphatic sense – has freed itself both from technological views of music and from speculative and moralizing views. Allegorical interpretations are in dispute; moral postulates are rejected as intrusions from outside, foreign to art; instructions in craft and recipe books of *musica practica*, ever since Fox's *Gradus ad Parnassum*, have been sinking more and more into mere exercises in a dead language (Dahlhaus 1982: 14).

This raises an interesting dilemma. If 'instructions in the craft' increasingly counted as a 'dead language', alienated from what Ruth Solie calls the 'living work' (1980: 147), what kind of theoretical work took its place in the nineteenth century? Also, how are we to theorize the relation between the proliferation of theoretical treatises and the autonomous work of art if the emancipation from guiding principles lay at the heart of the latter? One response might be to claim that Dahlhaus overstates the case regarding the valuelessness of instruction in the nineteenth century and then to harness historical evidence to argue against this position. Another response might be to argue that Dahlhaus fails to distinguish here between what, in his semiotic model, Jean-Jacques Nattiez designates as the 'esthetic' from what he designates as the 'poetic', and that Dahlhaus thus conflates categories. By implying an affinity amongst 'allegorical interpretations', 'moral postulates' and 'instructions in craft', Dahlhaus implicitly claims an equivalence between interpretation and composition. However an equivalence between a resistance to interpretative prescriptions and a resistance to compositional prescriptions cannot be self-evidently claimed. Hence each 'dimension' requires a separate investigation.

But these are not the approaches I wish to pursue, for they overlook a possible clue to solving the dilemma that Dahlhaus's formulation implicitly provides. If the isolated, self-contained work becomes 'the supreme reality of art', as Walter Benjamin argues in his *Origin of the German Tragic Drama*, then it makes strong, new demands on a listener.

Existing for its own inner perfection alone, it need not have a stable semantic meaning that the audience necessarily recognizes or judges according to some mimetic principle. The autonomous work, enduring in itself, gains an elevated ontological status and takes on metaphysical significance. Invoking Friedrich Nietzsche, James Currie in a recent unpublished paper entitled 'Musical Autonomy and Dialogue in Late Eighteenth Century Music' characterizes this paradigmatic shift thus:

The musical effects which had initially been dismissed as incoherent by Fontanelle, "...because of... their lack of inherent semantic meaning, have become a source of great power having the 'double quality' of a narcotic that both intoxicates and spreads like a fog." [Nietzsche] The listening subject, at times unable to rationalize the musical world in which he finds himself, now experiences frustration and fear, or simply relinquishes himself to the music's effect, recognizing its superior power as if it were a sign of metaphysics (Currie 1993, 7).

Detached from a broader practical or moral purpose, music becomes a self-governing whole capable of excluding its own (metaphysical) powers. However, the moment the work becomes 'whole' in itself, breaking with a more comprehensive whole, it becomes profoundly alienated from the listening subject to whom it is no longer subversive. It changes from a functioning object to an autonomous object to be contemplated and interpreted. Paradoxically, by resisting a *priori* textual significance, the work is now the locus of interpretation from the obvious to the obscure takes place: the work is rendered as pure text. A shift demanding active decoding and understanding. Adolph B. Marx, in his introductory article to the *Berliner Allgemeine Musikalische Zeitung* of 1824, articulates this shifting role of the critic. The artwork now makes demands on criticism. The work carries a spiritual essence (*Idee*) that is both unique and unified, and can be identified by the critic only by surrendering to the work. Scott Burnham likens Marx's new, spiritually charged interpretative activity to the process of divination.

Marx claims that the analysis of musical works cannot be limited to the intellect (*Verstand*) alone; a more spiritual approach is needed to confront the 'inseparable spiritual capabilities' of the artist. The concept of wholeness, of totality, is crucial to this communion between artist and interpreter. What is implied here is the reception of a totality (an artwork born of the powers of a human being) by another totality (the totality of an artwork, is the totality of one's own spirit (1990, 186).

The act of divining the *Idee* from an enduring totality takes its cue from textual hermeneutics. Friedrich Schleiermacher (1768-1834), who was a colleague of Marx at the University of Berlin, advanced a defense of divination as central to the hermeneutic act. The critic grasps the essence of the work through a spiritual identification. In other words, the work, as a unified totality and thus as 'a manifestation of universal life', resembles the self (Burnham 1990, 186). True understanding is achieved only when this identification is made.

The paradox inherent in this position emerges if one inspects more closely the nature of the 'totalities' concerned. According to Burnham, Marx insists on the importance of the totality of all the factors involved – the work, the artist and the interpreter' (1990, 186). It is only insofar as the work is a self-sufficient totality that a spiritual identification with it becomes necessary. But this identification is by no means automatic; indeed the critic needs to engage the work actively in order to grasp it. The work assumes an alienated relationship with its audience, and since the link between listener and work is no longer immediate, meanings are no longer self-evident. Work and listener take on the character of isolated, free-floating and independent 'totalities' with no necessary relation to one another. Again, the point is that this alienated relation is the very product of an artwork configured as a metaphysical whole.

This point enables us to make sense of Dahlhaus's apparently contradictory relegation of instructional treatises because of the relation between treatises and refined art objects. That is, the very demotion of theoretical work paradoxically, but necessarily, gave rise to an abundance of it. Standing a certain distance apart from the musical work, theoretical har-

gauge thus increasingly searches for a logic that is free from its own vocabularies, obscurities and contingencies in order to comprehend more clearly the musical text. This paradox can be situated in the broader context of a crisis in the nineteenth century regarding the status of language generally. Michel Foucault characterizes one of the consequences of this textual 'gap' in terms of a desire for transparency between language and object (in this case science) which can no longer be attained:

[Language] ... cannot itself be arranged, deployed and analyzed beneath the gaze of a science, because it always re-enters on the side of the knowing subject – as soon as the subject expresses what he knows. Hence ... [a] ... constant concern ... throughout the nineteenth century ... [is] ... the wish to neutralize and, as it were, to polish scientific language to the point at which, stripped of all its singularity, purified of all its accidents and alien elements – as though they did not belong to its essence – it could become the exact reflection, the perfect double, the unmissed mirror of non-verbal knowledge (1973: 296).

It is no wonder then, owing to the distance that arose between language and musical works, that a vast amount of material was being written about works of music. As Dahlhaus argues in his *Nineteenth-Century Music*, music now posed a challenge to decipherment (1989: 10-11).

It stands to reason, then, that an increased emphasis was put on the analysis of works themselves instead of on outlining compositional models. Take the cases of Heinrich Koch (1749-1816) and Jérôme-Joseph Momigny (1762-1842), who, in this respect, represent antipodes at the threshold of this methodological shift. On the one hand, Koch still couches his influential theory of 'melodic phrase structure' and 'formal model' in the terms of a compositional strategy rather than in those of an analysis. In his *Versuch einer Anleitung zur Composition* (1782-93), Koch's formal model reflects eighteenth-century taxonomic thinking, offering a model (*Anlage*), derived from Sulzer, that sets down a plan for a work and its most salient features. The artist, following this model, is then to proceed to the "execution" (*Ausführung*) or completion of design and finally the "elaboration" (*Ausarbeitung*) of the work in all its details' (Bent 1987, 15). Various musical 'types' (gavotte, polonaise, minuet, etc.) are then described in terms of their overall plans and their inherent characteristics, including their characteristic emotional profiles. Besides a brief analysis of Haydn's Divertimento in G, Koch does not analyze any actual musical works, offering instead a host of his own examples to illustrate his points.

On the other hand, in Momigny's *Cours complet d'harmonie et de composition* (1803-1806), the project of analyzing examples from the emerging concert repertoire becomes a growing priority. In his Preface, Momigny heralds a 'new theory' which he attempts to ground, firstly, on the 'true interpretation of nature' and, secondly, on 'meticulous analysis of good musical compositions' (quoted in Bent 1994: 1). The analysis of musical works becomes indispensable to the training of composers. Compositional models lose their authoritative charge; the metaphysically elevated work of art demands contemplation and interpretation. Towards the end of the nineteenth century, analysis became a discipline in its own right. In short, the 'work' demanded 'analysis'.

For all his innovations, Momigny does not go so far as to reject the acoustical basis of music. Nature furnished by the resonance of the sonorous body equally mediates the interpretation of the work (Momigny quoted in Bent 1994: 1). The question now arises: What significance, if any, does a 'natural' explanation take if the work of art is a self-contained whole, divorced from external interference? This leads us to a consideration of the changing role 'nature' was to take in theories of chord generation over this period.

Resisting Natural Explanations in Music Theory

Jean-Jacques Rameau was perhaps the best known Enlightenment figure who strove to account for music in terms of mathematics and the observation of natural phenomena. For Rameau the source of music lay in nature, although his attempt to account for this source

changed over time. In his *Traité de l'harmonie* of 1722, the intervals comprising his chorals were derived from a systematic division of the string. In the tradition of Descartes, Rameau sought first principles that could provide a basis for music within a broader system. However, by the time of the *Nouveau Système* of 1726, which acknowledges the acoustical ideas of Joseph Sauveur, Rameau grounds these principles in empirical fact. Not only are the intervals numerically related to the fundamental but they are actually generated by it. Rameau's increasing empiricism reflected the Enlightenment ideal of a correspondence between world and idea.

Despite his innovations in providing a basis for this correspondence, Rameau did not go unchallenged in the eighteenth century. In fact, the scientific community (from whom he constantly sought recognition) almost unanimously rejected his findings, charging him with a lack of inductive rigor. For example, Pierre-Joseph Rousset (1716-92) criticized him in the following terms: 'Founder of Harmony [Rameau]... sometimes forgot this principle [Rousset's interpretation of fundamental bass] in his writings, substituting concepts of [musical] practice and routine from which he was unable to completely free himself, as they had been unfortunately inculcated into him since early childhood' (quoted in Gesselle 1989: 170). Rameau's explanations failed insofar as they lacked empirical evidence. Unable to explain the minor third in terms of the *corps sonore*, for instance, Rameau harnessed a faith in numerical ratios (underscored by the numerical equivalence of the first six partials with the string divisions) to explain it arithmetically. He also advanced the idea that a co-vibrating set of 'undertones' resonated with the fundamental when two additional strings were tuned a twelfth and a seventeenth below it. But as John Neubauer points out, 'no such vibration was observable, and in any case it would have destroyed Rameau's principle that the generating sound had to be the bottom note in the univerted chord' (1986: 80).

Rameau was also persistently criticized by music theorists. Initially this criticism took the same basis as that of the scientific community: Rameau's theory lacked empirical proof. It relied too heavily on an outdated Pythagoreanism and failed to tally with experience. Neubauer argues that after the writings of Weyckmeister appeared around 1700, Pythagoreanism was replaced by a growing empiricism (1986: 17). Johann Matheson was the decisive empiricist rejecting the mathematical tradition with constant references to empiricists such as Francis Bacon, Sauveur and John Locke. In *Das forschende Orchester* (1721), Matheson stated: 'My theoretical and practical principles in music came from experience, through the senses...' (quoted by Neubauer 1986: 19). Numerical relations, for Matheson, were abstractions from experience and could serve as no more than technical tools. They had no relation to an abstract metaphysical order. It is not surprising that Matheson dismissed Rameau – that an abstract metaphysical order. It is not surprising that Matheson dismissed Rameau – that an abstract metaphysical order. It is not surprising that Matheson dismissed Rameau – that an abstract metaphysical order.

When considering the history of the criticism of Rameau, significance can be found in the changing facets of the theory that are identified as problematic.

In his clash with the *philosophes* in the 1750s, for instance, it was Rameau's physical laws of sonorous bodies that were most vehemently contested. Jean-Jacques Rousseau held that history and culture conditioned the ear and that the ear was thus capable of growing accustomed to novel chord combinations. A similar concern for flexibility and experimentation lay at the heart of Jean-Léonard d'Alembert's *Reflexions sur la musique* (1777):

Once we find the theory of music, it will not be, as one may first think, an object of pure speculation that explains poorly or well the pleasure awakened in us by melody and harmony. Discovering the true sources of that pleasure, we could also find there the means to provide new pleasures in that art (quoted in Neubauer 1986: 105).

D'Alembert and Rousseau agreed that the rules for harmony were less a phenomenon that was 'natural' than they were 'products of reflection' (Neubauer 1986: 106).

Whereas Matheson and Rousset oppose Rameau because he offers insufficient empirical support for his theory, Rousseau and d'Alembert accuse him of advancing too much of this

type of support. Rousseau emphasized those aspects of the theory that attempted to link music with nature, and d'Alembert emphasized the 'rational' and 'constructivist' elements of the theory. Neubauer sees the concern for mathematical relations in music as a major factor in the emancipation of music from language and says that the interest in formal organization *per se* throughout the eighteenth century increased in inverse proportion to the interest in mimesis as an aesthetic principle. But the new constructivism was different from the older Pythagoreanism. In the words of Neubauer, 'the theory of instrumental music and the principles of a new aesthetics were largely inspired by mathematics as a "construction" that starts with axiomatically adopted generating principles rather than with "facts of nature" and terminates in a self-contained structure' (1986: 173).

The emergent Pythagoreanism was thus severed from the material world, giving rise to the possibility of an autonomous artwork whose meaning resided in a network of internal relations alone. To understand the resistance of music to nature and to language as Romantic irrationalism, or what Neubauer calls 'a surrender to the chaos of emotions' (1986: 199) fails to consider the transformative potential of mathematics with regard to the artwork. As a free-floating complex of relations, mathematics could transform sound in its materiality into pure form. In two separate passages Wackenroder describes this power in terms of magic:

From what kind of magical preparation does the scent of this splendid world arise now? – I observe and find nothing but a wretched texture of numerical proportions, palpably presented in drilled wood and on frames of gut and brass wire. – This is almost more miraculous, and I am inclined to believe that God's unseen hand climes in with our sounds and endows the human texture of numbers with heavenly force.

All sonorous affects are ruled and guided by the dry, scientific number system, as if by the odd, magic-conjuring formulas of an old, fearsome magician. (both passages as quoted in Neubauer 1986: 199-200; my emphasis)

The mysticism implied here must be distinguished from the cosmically charged Pythagoreanism of the ancients.⁵ Music is not connected to the cosmos via certain immutable numerical relations found in nature, but rather disconnected therefrom in the form of a self-governing whole. The mathematical relations facilitate the possibility of an independent totality sealed off from the larger context.

On the one hand, numbers are seen as 'wretched and dry'; on the other hand, they are endowed with the power to perform miracles. Neubauer thus concludes that mathematics is the means by which 'music ... rid[s] itself altogether of the burden of imitation'; and, citing Wackenroder, that 'the sounds which art has miraculously discovered and pursues along the greatest variety of paths ... do not imitate and do not beautify; rather, they constitute a separate world for themselves' (1986: 200).⁶ In short, self-contained systems, 'dry' as they may be, are a necessary condition for a self-contained, metaphysically elevated, artwork.

Leo Spitzer, in *Classical and Christian Ideas of World Harmony, Prolegomena to an Interpretation of the Word 'Stimmung'*, reaches the conclusion that 'the Pythagorean concept of world harmony was revived in modern civilization whenever Platonism was revived; and the German word 'Stimmung' is the fruit of one of these revivals' (1963: 3). In other words, when the autonomous work of art takes on the character of a quasi-Platonic form, there is a corresponding resurgence of Pythagorean mathematics. This is similar to Neubauer's statement that the rise of instrumental music, freed from the burden of imitation and representation, witnessed an increase of mathematical conceptions of music. In certain crucial ways then, a kind of Pythagoreanism constituted the very basis of the emergent Romantic aesthetics.

At a glance, Neubauer's model does not seem to square with early nineteenth-century theoretical treatises. For example, in Vol. I of his *Versuch einer geordneten Theorie der Tonsetzkunst* (1817), Gottfried Weber seems to shun what Bent calls 'the parading of arithmetical and algebraic formulas ...' [for Weber] ... the entire mathematical treatment of musical composition was an illusion' (Bent 1994: 1, 10). According to Weber's, 'innermost conviction, it is a truly incomprehensible mistake on the part of music teachers to mix into

the teaching of composition ... demonstrations with fractions, powers, roots and equations, and other examples of computation, with which to proceed to discourse on the theory of composition' (Weber quoted in Saslaw 1992: 26). Marx too, in his attempt to provide a foundation for a new program for music criticism, denounces the 'counting [of] syllables' that characterizes the older strain of criticism (see Burnham 1990: 184). François-Joseph Fétis also rejected mathematics as a foundation for his theory. In a letter to his publisher, Fétis explicitly defends his stand against mathematics. For Fétis, the origin for music cannot lie in the 'laws of calculus', but is to be found rather in the realm of the metaphysical (see Schellhous, 1991: 222). In short, all of this evidence seems to contradict the idea of a resurging Pythagoreanism.

However, a word of caution should be sounded. Although Weber, Marx, and Fétis, mentioned above as examples, reject mathematics as a basis for music, their statements are consistently coupled with a rejection of acoustics. Hence, the rejection of mathematics is solicited in defense of a spiritual or a metaphysical conception of music, free from extramusical determination. In other words, the mathematics referred to here is identified with the numerical relations inherent to various external phenomena. Take the full citation from Fétis:

But someone will ask, what is the origin of these scales, what is it that controls the order of their tones, if it is not acoustical phenomena, and the laws of calculus? I reply that their origin is purely metaphysical: we conceive this order, and the melodic and harmonic phenomena that ensue from it, as a consequence of our mental make-up and of our education. For us it exists as a fact in its own right, independent of all causes extraneous to us (quoted in Bent 1994: 1, 10).

The 'laws of calculus' are appended here to 'acoustical phenomena'. They are rejected only insofar as they represent a 'cause extraneous to us', and not because of their representing a system of abstract relations. Fétis does not deny the presence of ordered relationships among sounds at all; indeed something does 'control the order of their tones', but this principle cannot be derived from external phenomena. Hence, his denunciation of 'mathematics' has a specific connotation that cannot be read too literally. It is rejected only insofar as it suggests natural phenomena.

Fétis's *Traité complet de la théorie et de la pratique de l'harmonie contenant la doctrine de la science et de l'art* (1844) aims to identify the laws governing musical systems. But the system (in this case, the system of *Tonalité*) is a purely metaphysical principle located specifically in the human mental faculty. It is the condition of the possibility of musical thought. It prescribes laws to, rather than derives laws from, 'nature'. This does not imply a wholesale rejection of 'mathematics' in the sense ascribed by Neubaer. Rosalie Schellhous, in fact, suggests a lineage between Fétis and Gottfried Wilhelm Leibniz, one of the leading mathematicians of music in the eighteenth century, via Fétis's colleague at the Paris Conservatory, Alexandre Choron (1991: 224-25). Leibniz describes music as an 'unconscious exercise in arithmetic in which the mind does not know that it is counting' (quoted in Neubaer 1986: 174). This understanding is an early version of a metaphysical theory of music that is governed by laws that are deduced *a priori*. This is exactly the type of system that Fétis set out to explain.⁸

In *The World as Will and Representation* (1819), Schopenhauer, the arch-romantic, almost echoes the words of Leibniz: 'Music is an unconscious exercise in metaphysics in which the mind does not know it is philosophizing' (quoted in Neubaer 1986: 175). Schopenhauer also explains the metaphysical nature of the 'mathematics' involved in the musical experience: 'We must attribute to music a far more serious and deep significance ... in reference to which the arithmetical proportions, to which it may be reduced, are related, not as the thing signified, but merely as the sign' (quoted in Dahlhaus and Katz 1987: 148). Importantly, Schopenhauer points out that these mathematics should not function as an explanation (the thing signified) for the workings of music, but as a paradoxical experience of the necessary,

infallible and utterly proximate movements of the Will. The proportions posited in this schema have no link with natural phenomena, they have been dematerialized, rendered as operations of a pure metaphysical movement.

Indeed the presence of a dematerialized Pythagoreanism is felt in the writings of many of the early nineteenth-century theorists. For instance, although the number of musical forms in Marx's *Die Lehre von der musikalischen Komposition* (1837-47) is 'unlimited', there must still be 'some *rational* underlying these moulds, some concept which is of broader significance' (quoted in Bent 1987: 28; my emphasis). To excavate this underlying governing principle, albeit one that is severed from any necessary connections with nature, is thus central to Marx's project.

In a similar way, Weber's concept of *Mehrdeutigkeit* (Multiple Meaning) takes its cue from the constructivist elements of Rameau's theory, most notably the concept of *double emploi*.⁹ According to Saslaw, Rameau, 'starting from the double interpretation of a single chord ... created a concept that can be applied to many different chords and locations, as well as to the individual pitches contained in chords. In this sense *double emploi* and the 'community' of chords are true predecessors of Weber's Multiple Meaning' (1992: 46).¹⁰ It is crucial to note that the very condition for the possibility of Multiple Meaning – whether this applies to keys, intervals or harmonies – is an underlying constructivist principle. For example, all chords lose the one-to-one relation they once had to nature; their structure no longer determines their function.¹¹ Instead, the meaning of a chord can be fixed only in relation to its function in a broader context of harmonic relations and thus only fleetingly. These relations, albeit dematerialized, signal the realm of pure possibility and thus, in this respect, embody a latent Pythagoreanism.¹²

The Relation between Romantic Aesthetics and Science Reconsidered

In a section entitled 'Nature Versus Mind as Organizing Principle' from the first volume of *Musical Analysis in the Nineteenth Century*, Ian Bent identifies a host of other theorists who, far from 'dematerializing' Rameau's theory, preserved its central tenets. Bent, in fact, suggests a resurgence of interest in the overtone (and undertone) series after the research of more recent scientists such as Herman von Helmholtz. Both Arthur von Öttingen and Hugo Riemann, for example, attempt to ground their theories in acoustics, and it is with regard to these later theorists, I take issue with Neubaer's identification of Romanticism embodying an emergent Pythagoreanism.

In *Das ideale Harmoniesystem* (1900), Öttingen articulated a dualistic theory of harmony, separating those harmonies that possess the attributes of 'tonicity' from those that possess the attributes of 'phonicity'. That is, the elements of any *Klang* either possessed a common fundamental (below them) or a common overtone (above them). The former resulted in a major triad, while the latter resulted in a minor triad. Thus the formations of major and minor were, on the one hand, held to be rooted in natural acoustic phenomena and, on the other, held to be in a symmetrical relation to each other.

Riemann also sought to justify the major and the minor in terms of acoustics. He wrote in his *Lektion* of 1882 that, amongst other things, a system of harmony endeavours to evolve the *natural laws* of musical, and especially harmonic, formation' (Riemann 1897: 325, my emphasis). Under '*Klang*' he offers a scientific explanation grounded in acoustics:

Klang, Sound is the name given to audible vibrations of elastic bodies, i.e. C, or S, is the scientific word for the lay term tone ... The height of the C, is determined by the pitch of the lowest, and, as a rule, the strongest of its compound tones, which are also called Partial tones, Aliquot tones, Scale of nature (Riemann 1897: 143).

In his explanations of major and minor 'consonance' Riemann adopts Öttingen's reasoning, citing him as an authority:

it cannot be doubted that the consonance of the major chord (major consonance) must be referred to the series of overtones The minor tone is related to a series of undertones in precisely the same way as the major consonance to the overtones: the phenomenon in acoustics which justifies the acceptance [sic] of this undertone series are those of sympathetic and combination tones (Riemann 1897: 144).

It seems to stand to reason that neither Riemann's nor Öttingen's invocations of acoustical explanations in the service of harmonic dualism can be adequately accounted for in Neuberger's model as it stands. Even those theorists who emphatically rejected Rameau, frequently failed to fully resist the force of a 'natural' explanation. For example, Moritz Hauptmann, whose rejection of the role of acoustics as a foundation for harmony in *Die Natur der Harmonik und Metrik* (1853) seems to break completely with the natural basis for the triad, adducing instead a 'philosophical triad of Hegelian dialectics' (Bent 1994: 11), nevertheless posits as axiomatic an even older appeal to 'nature', in the form of the string divisions and their ratios. To be sure, Hauptmann does not treat string divisions as sufficient in themselves but instead puts them into the service of a Hegelian dialectic, whereby 'the Octave is the expression for unity; the Fifth expresses duality or separation; the Third, unity of duality or union. The Third is the union of Octave and Fifth. Before union separation must exist, and before separation unity' (1893: 6). Now although these dialectical relationships are intelligible only in consciousness and thus, in Bent's terms, subscribe to 'mind' rather than 'nature' as the organizing principle, there is no theoretical justification for using exactly those mathematical proportions that are found in the simple division of the string. Hauptmann attempts to dematerialize this Pythagorean invocation by directly confronting the issue of the production of sound and its relation to music.

Sound exists as a phenomenon through a material means: to its production there is requisite a body specially conditioned, and elastic vibratory movement of that body. But sound in its essence is not contained in the material as an utterance of qualitative attribute. What we perceive as the phenomenon of sound is only the coming into being of the abstract inner form of unity....the abstract relation in which these factors stand to one another (1893: 4; my emphasis).

Yet despite these assurances Hauptmann still maintains that certain intervals are somehow immediately and inevitably inscribed in consciousness. In introducing the major triad he states: 'There are three intervals directly intelligible: I. Octave II. Fifth III. Third (major). They are unchangeable' (1893: 5). But how can they be 'unchangeable' in a strictly relational dialectical process? What force, if not nature, can fix immutably these axiomatic proportions? And what does this imply about the autonomous artwork? Must it not pay heed to this unchangeable fact of nature?²⁶

Thus Hauptmann's text unwittingly enacts a dialectic between natural immutability and abstract relationality rather than simply describing the dialectical relations between intervals in the abstract. This unintended moment begins to argue against a strict division between theories that resist the explanatory power of nature and those that embrace it. In fact, the problematic relation between music and nature remains unresolved for music theorists right into the twentieth century, as much with those who seek to transcend it as with those who do not. However, this relation was a constantly shifting one, in many ways implicated precisely in the puzzles implicit in viewing the work of art as an autonomous totality.

Before offering an analysis of the relationship that these late nineteenth-century theories do take to the then prevalent aesthetics of autonomy, it is necessary to take a closer look at the relationship between 'art' and 'science' generally in the nineteenth century, and then to assess the degree to which music theory operated in the realm of one or the other. In other words, in order to locate, more specifically, the discourse of music theory, we must distinguish the aims of 'art' and 'aesthetics' from those of 'science'. In many ways the opposition between the 'artistic' and the 'scientific' is a later incarnation of the opposition between the 'philosophical' and the 'speculative' mentioned at the outset of this paper. Again, it cannot be assumed that the respective aims of 'art' and 'science' overlap.

Most recent commentaries on the nineteenth century recognize this opposition implicitly. For example, in his article 'Symmetry and Symmetrical Inversion in Turn-of-the-Century Theory and Practice', David W. Bernstein posits an inevitable parallelism between music theory and science in an age of rampant positivism (1993: 379). In this way theory becomes the antipode of the musical work which is regarded as a mysterious organic unity. Schellhous too opposes the ascendancy of positivism from the metaphysical nature of music (as propounded by Fétis). She states: 'from the growing ranks of scientific positivists, a metaphysical principle [music] could have no place in an empirical enquiry' (1991: 219). However, unlike Bernstein, the positivist onslaught for Schellhous alienated rather than appropriated music theory. That is, for Bernstein, there was a parallelism between music theory and science, while for Schellhous there was an antagonism between the two. Contradictory as they may seem, these views actually illuminate a relationship between 'science' and 'art' that argues against a simple historical binarism. I will return to this point shortly.

For Terry Eagleton, commenting from another angle, this opposition underlies a deeper social rupture. The autonomous literary work contrasts the fragmented individualism of the capitalist marketplace: 'it is "spontaneous" rather than rationally calculated, creative rather than mechanical' (1983: 19-20). In other words, the 'aesthetic' is contrasted to the 'positivistic'. "Imaginative creation" can be offered as an image of non-alienated labour; the intuitive, transcendental scope of the poetic mind can provide a living criticism of those rationalist or empiricist ideologies enslaved to "fact" (1983: 19). In this reading, an aesthetic idealism is the very inverse of a positivistic realism.

Bernstein, Schellhous, and Eagleton, then, all acknowledge a separation between two distinct fields: the scientific, empirical realm of positivism, on the one hand, and the spiritual, organic realm of the aesthetic on the other – whether they regard each side of the opposition as signaling a deeper social crisis or simply as mutually incompatible.²⁷ From this vantage point, one could argue that Riemann's work, although it straddles these two fields, observes a clear distinction between them. His invocation of acoustics, for instance, serves to define the concept of *Klang*. But precisely this concept is the 'scientific' word for the lay term 'tone' (Riemann 1897: 143; my emphasis); it is 'the name given to audible vibrations of elastic bodies' (1897: 143). Now, although a *Klang* may possess a major or minor valence in terms of acoustics, this is not strictly recognized as a harmony/chord in music. In order to qualify as such, the mental faculty is called into play. Thus under 'Harmony' Riemann writes:

Harmony, System of, is one which explains the meaning of harmonies (chords), i.e. the definition of the mental processes in listening to music ... it exercises musical imagination in a systematic manner (Riemann 1897: 325; emphasis original)

The scientific term *Klang* must therefore be carefully distinguished from the concept of musical harmony. The former is a fact of nature with no necessary correspondence to the workings of music. The latter is a 'mental process'. The distinction is elaborated in Riemann's definition of 'Consonance'. Here Riemann demonstrates how tones 'that can be regarded as the same clang' can change their meaning according to musical context (1897: 161). In sum, '*Klang*' and 'Harmony' cannot be conflated in Riemann's theory. Thus Riemann's invocation of natural phenomena bears little resemblance to that of Rameau where the structure of a chord, immutably inscribed by the natural world, had a direct relation with its function in a musical setting. Indeed, in his *Handbuch der Harmonielehre* (1890) Riemann explicitly denies the role of scientific explanations for music, emphasizing instead the role of the mind.

In other words, the musical consonance is neither a physical nor a physiological concept, but rather a psychological one; it is not the result of variously combined sound waves or sound sensations, but rather the result of its variously combined presentations [in a musical context] (159; my translation).

Riemann proceeds to explain that it is only in relation to other chords that we can correctly identify any chord. It is these internal relationships, and not any external factors, that give

rise to musical meaning. Furthermore, in the spirit of Marx and Pétis, these relationships are discovered through the mind alone. Music and science are thus systematically separated in Riemann's account.

In this interpretation, historical times could probably be drawn between 'empirically oriented' and 'aesthetically-oriented' theories of the late nineteenth century, with theorists like Georg Capellen and Arthur von Oettingen on the one side and Moritz Hauptmann and Hugo Riemann on the other respectively. But this seems to be a simplification. Why does Riemann engage the scientific findings of Helmholtz and others at all if they play no role in the logic of the purely musical? In fact, the logic of the acoustical explanations pervades the realm of the purely musical? For example, the entire system presented in his *Handbuch der Harmonielehre* is predicated on an 'upward' configuration of the major and a 'downward' configuration of the minor. This applies both to the structure of the chords and to the progressions between them. A 'schlichter Quintarschluss', for example, is a progression of a fifth that in the major key is always configured upwards and in the minor key always downwards. These relations are patently derived from the alleged acoustical structure of the respective major and minor *Klänge*. To return to the definition of *Klang* in the *Lexikon*, 'the minor consonance is related to the series of undertones ... the major consonance to the series of overtones' (Riemann 1882: 143). We can see, therefore, that in much the same way that Hauptmann's 'philosophical' triad (the elements of which exist in enantia relationships as axiomatic, Riemann's harmonic progressions are shared by certain naturally inscribed acoustical foundations. The border between the empirically fixed and the psychologically ascertained has become gradually porous. This begins to suggest an altogether different complex of relations between 'art' and 'science' to the one implied by Schillhaus, by Bernstein or by Eagleton. To invoke Foucault once more: the 'neutralized' language, stripped of all 'accidents and alien elements' (1970: 296), that the author posits as a nineteenth century ideal, bears a striking resemblance to the 'symbolic' language that aims to 'represent ... the forms and connections of thought outside all language' (1970: 297). Music, figured as an autonomous self-referential totality, is an instance of such a 'language outside all language'. But Foucault simultaneously identifies the desire for a purified language with the 'positivist dream' to form a faithful 'copy' of nature (1970: 297). According to Foucault, such a language sought to 'become the exact reflection, the perfect double, the unmissed mirror of a non-verbal knowledge' (1970: 296). It is as if 'science' and 'art', sealed off from one another by their mutually exclusive concerns, in fact speak the same language. In certain significant ways both strive for an internally coherent system of relations that governs a totality.

An example of this can be found in the concept of symmetry as it impacted both artistic and scientific activity. Towards the end of the nineteenth century, inversion and involutional symmetry evolved into fundamental concepts – metaphors in various scientific disciplines, such as biology, physics, crystallography, music theory, sexology, and group theory. While a single definition cannot capture the various figurations of the term within these disciplines, the concept broadly referred to the formal constitution of a natural phenomenon in terms that involved equivalent polar opposites. Thus, a natural phenomenon was divided into two segments that reflected each other, as if in a mirror, to yield equal, but oppositely projected parts of a whole. Like the geometric symmetry of the crystal, whose mathematical theorizing was entirely a product of the late nineteenth century, phenomena like the sexual 'invert' or the musical 'minor sonority' were explained in terms, firstly, that involved symmetrically reflecting opposites (or inversions), and secondly, that were empirically fundamental to their theories – that is, the mirror reflections were regarded as natural occurrences given in the empirical world, instead of as constructed or derived. Hence both sides of the opposition were granted empirical factuality. Bernstein points out studies which illustrate the prevalence of analogous symmetrical relationships in the music of Beethoven, Schubert,

Chopin, Wagner, Liszt and Mahler (1993: 378). To the music cited in these studies should be added the early modern works of Schoenberg and Webern in which the unfolding of involutional symmetries is central to the compositional procedure. This juxtaposition of musical examples with scientific theories suggests a deeper discursive affinity between them – an affinity that undermines the separation implied by the binary opposition of idealist and positivist.

To return to Oettingen as an example: despite its empirical orientation, Oettingen's theory gains its strength less from the acoustical data that purportedly underlie the 'tonicity' (of the major triad) and the 'phonicity' (of the minor), than from the perfectly symmetrical relation these triads take to one other. Symmetries also pervaded other aspects of his theory. In Oettingen's words:

The inner duality or 'twofoldness' of harmony also permits an outer, dual, i.e., a twofold-opposite form of development of the harmonic system that makes itself known in a symmetrical construction of all tone structures and chord progressions (quoted in Bernstein 1993: 385).

Throughout *Das duale Harmoniesystem* Oettingen employs elaborate diagrams to illustrate these symmetries. Everything from the structure of the major and minor chords to the structure of certain harmonic progressions are determined by symmetrical equivalence in his system.

Without describing this theory in any more detail, it can already be noted that it is the symmetrical relations themselves that are offered as carrying the bulk of the explanatory power. They become the 'narrative' mode through which 'scientific' sense is made. In Hayden White's language, the world never really comes to us 'already narrativized, already "speaking itself" from beyond the horizon of our capacity to make sense of it ... [but instead] display[s] itself as the form of a story, necessary for the establishment of that moral authority without which the notion of a specifically ... [scientific] reality would not be possible' (1987: 23). Thus, for White, the authority of science lies less on an empirical plane than on a moral one. Bernstein, in contrast, connects the emphasis placed on symmetries to a 'positivistic world view', a rational, nonchaotic, and scientifically justified *Weltanschauung*, which inspired music theorists and scientists alike (1993: 380). Hence, Bernstein would place Oettingen firmly in the positivist camp.

But symmetries also played an important role in many of the musical works of the nineteenth century. For example, some of Brahms's late work can be successfully analyzed in terms of a phonically mapped symmetrical compositional terrain.¹⁵ But musical works, if anything, are 'aesthetic' rather than 'scientific' phenomena. It seems that a kind of symmetrical form in this case, or a 'constructivism' in the broadest sense, seems to play a significantly analogous role in the formation of both the 'aesthetic' and the 'scientific' object. One of the arguments put forward in this paper is that intrinsic to the notion of an autonomous, self-governing artwork lies a formal principle of organization. I will now propose that this principle is not all that different from the formal principles that govern science. Instead of understanding 'art' and 'science' as necessarily distinct, as suggested by most of the writers mentioned above, art and science thus share the same discursive profile. In short, the musical work is paradoxically shot through with the ideology of scientific positivism the moment it declares itself autonomous.

In this view we can make sense of the many paradoxes gestured towards in this paper. Take the case of Webern, who felt that his works were beholden to the 'unifying laws' of nature (1975: 56). In *The Path to New Music*, Webern states that when the 'true conception of art is achieved, then there will no longer be any possible distinction between science and inspired creation. The further one presses forward, the greater becomes the identity of everything, and finally we have the impression of being faced by a work not of man but of Nature' (1975: 56). But Webern's appeal to scientific progress was concerned with nature's laws understood as unifying the perception of different symmetrical inversions (in this case),

recognizing them in terms of variations of the same idea. A musical idea and its inversion, say, may have appeared distinct on the surface but were, in fact, presentations of the same bottom of everything' (1975: 53). Science, in Weber's world thus unifies both living outer appearance.

More generally, take Wackenroder's invocation of the alchemical power of mathematics magically to transform the materiality of sound into pure form. To reiterate Wackenroder: 'All sonorous affects are ruled and guided by the dry, scientific number system, as if by the odd, magic-conjuring formulas of an old, fearsome magician' (quoted in Neubauer 1986: 199). Self-contained systems, albeit 'dry' for Wackenroder, are a necessary condition for a self-contained, metaphysically elevated artwork. But how different is this magic from the magic of a scientific explanation offered by, say, Othigen? For a start, both owe a mandate to allegiance to inner coherence and a kind of self-regulating internal symmetry. Far from existing in a relation of mutual exclusivity then, nineteenth-century art and science are in a relation of resemblance and affinity: the 'ground of their positivity', in Foucault's terms, is identical (1970: 297).¹⁷

Hence, while naturalist explanations of music gradually recede in nineteenth-century musical treatises, giving way to a metaphysically infected conception of its inner workings that was more in sync with the aesthetics of autonomy, a re-examination of the relations between science and art on the terrain of music theory and composition in the late nineteenth century reveals that they share a variety of features. Without forgetting their differences, the discursive affinity between their procedures raises a host of interesting questions about how to understand the concept of autonomy in the first place. Even in Kant's formalist scheme, aesthetic freedom bridged the gap between ethics and the scientific world – an idea that became increasingly important for the romantic connection of art to truth. This conception of anti-formalism in our discipline would have it. For, while the bridging function of aesthetic judgment issued forth the truth of art, it also laid bare the art of truth.

NOTES

1. An analogous parallel could be constructed on a different, but related, trajectory, namely that musical works and the theoretical treatises explicating them both seem to shift from a 'nature-centered' to an 'ego-centered' basis.
2. See Lydia Goehr's *The Imaginary Museum of Musical Works: an Essay in The Philosophy of Music* (1992) for a discussion of the emergent concept of the musical work.
3. For a fuller discussion of Rameau's scientific imperative, see Thomas Christensen's 'Eighteenth-Century Science and the *Corps sonore*: The Scientific Background to Rameau's Principle of Harmony' (1987: 23–50) and his *Rameau and Musical Thought in the Enlightenment* (1995: 33 ff.).
4. Neubauer makes the useful distinction between the 'generative-deductive' and the 'permutational' or 'constructivist' sides of Rameau's theory (1986: 78–84). He notes, for example, that D'Alembert's concern with chords as 'combinational possibilities' instead of as facts of nature is reflected in his choice of ten, rather than two, basic chord types (1986: 104).
5. It may be worth noting the similarities between Wackenroder's invocation of magical forces and the divination required to grasp the *Idee* in Marx's theoretical scheme.
6. For Neubauer, it seems, the 'transmutation of music from language' had first to pass through an 'emptied' phase (exemplified above by Matheson) in order for it to shed the cosmological significance attached by the older Pythagorean models.
7. Not only did Weber reject the Pythagoreanism mentioned here, but he also accepted an acoustical ontology for musical harmony. In this respect, he seems to defy the model represented above on two fronts.
8. This is not to argue that Fétis, in his rejection of an acoustical ontology, simply adopted a Pythagorean basis for his theory as a substitute. Instead, the aim here is to show how his invocation of Hegelian metaphysics itself owes an allegiance to mathematics.
9. Weber defines the concept of *Mehrwertigkeit* in the following way: 'Multiple Meaning is what we call the possibility of explaining an entity in more than one way, or the quality of an entity, whereby it can be

considered sometimes as this, sometimes as that' (in Saslaw 1992: 94). *Double emploi* – the multiple interpretation of a single chord – was initially introduced to solve a theoretical dilemma at the heart of Rameau's theory of harmony: it was impossible to coordinate the fundamental bass motion with the diatonic structure of the scale. In particular, scale degrees 6 and 7 could not be consecutively connected without breaking the prescription concerning the motion of fifths. In order to solve the dilemma, Rameau introduced the notion of *double emploi*, whereby a characteristic dissonance (the added seventh) – initially added symmetrically to the subdominant and the dominant – could be added to the chord of the sixth degree, in effect allowing it to be interpreted in two ways, one of which could lead to the chord of the seventh degree within established protocol.

10. Weber's ideas clearly owe their inspiration to a host of other sources, not least the aspect of 'permutation' (*gens combinatoire*) in eighteenth-century theory. Here I wish only to point out the important mathematical dimension that lies at the heart of Weber's *Mehrwertigkeit*.
11. For further discussion on these 'one-to-one' relations in Rameau, see Joel Lester's *Compositional Theory in the Eighteenth Century* (1992: 119, 139 and 209).
12. This argument is not intended to attribute aesthetic idealism to a latent Pythagoreanism *per se*, but to mark a not immediately apparent alliance between the two.
13. Interestingly, Hegel's own conceptions about music are cautious with respect to the autonomous work. Music considered as a self-sufficient living organism, expunged of all purpose, renders the listener secondary and this results in an asymmetry in the dialectical opposition. Thus for Hegel the ideal musical work must be able to maintain equality between work and listener. See Hegel's *Introductory Lectures on Aesthetics* (1993: 94–95).
14. Positivist science, in this view, developed as a counter – not as a complement – to philosophical idealism.
15. 'Mit anderen Worten: die musikalische Konsonanz ist weder ein physikalisches, noch ein physikologisches, sondern vielmehr ein psychologischer Begriff, nach dem das Organ so oder so zusammenzuführender Schallwellen oder Tönen empfunden, sondern so oder so kombiniert Tönen vorstellungen' (Riemann 1890: 139).
16. See my 'Asymmetrical Reading of Inversion in *fin de siècle* Music, Musicology and Sexology' in *Queering the Canon: Defying Signs in German Literatures and Culture* (Columbia, South Carolina: Camden Press, 1997), in which I offer a phonic reading of Brahms's String Quartet in G, op. 111.
17. Perhaps it is thus not surprising that Othigen (the 'empiricist/positivist') could derive much of his theory from Haupmann (the 'dialectician/idealist') without undue strain, despite their seemingly contradictory stances towards the role of nature. Nor is it surprising that Friedrich Wilhelm von Schelling's description of a science as 'a continuous connection of conditional theorems, of which the first, the axiom, is not conditional' (1980: 40) seems uncannily similar to Marx's exposition of the *Motif* as the starting point for music, 'the seed or sprout of the phase out of which it grows' (Schelling quoted in Bent 1987: 229). In science we have the axiom and in music we have the *Motif*. Both announce the starting points for a series of connections and relations that thread the theory/work into a self-governing whole. To speculate a little, the moral authority (to borrow from Hayden White) that informs both 'axiom' and 'motif' may just be the same.

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SUMMARY

A consideration of the relations between the harmonic and compositional treatises of the eighteenth and nineteenth centuries and the concurrent rise of the aesthetic autonomy shows that an increasing resistance to considering 'extra-musical' functions to be a property of the autonomous musical work resembles a contemporaneous resistance to 'extra-musical' theoretical explanations, in this case explanations for the generation of chords which depended upon string divisions, resonating bodies, and other natural phenomena. Both traditions shift from a 'nature-centered' to an 'ego-centered' basis.

Firstly, the article examines the idea of aesthetic autonomy which arose towards the end of the eighteenth century and suggests some of the ways that contemporaneous theorizing about music was affected by this aesthetic. Instead of functioning as a musical 'type', the autonomous musical work functioned as a self-governing whole imbued with metaphysical significance. Analysis, as a discipline, arose at this historical juncture. Secondly, the article tracks the changing role played by the observation of natural phenomena in theories of chord generation. The origin of chords and tones were now considered less as acoustical phenomena and more as metaphysical entities. Finally, the article considers the resurgence of interest in acoustics in the late nineteenth century in light of the above shift. This interest was not an independent development, unaffected by the aesthetics of autonomy, but was implicated in these aesthetics in a complex way. The history of relations between science and art involves less a rift than a deep regularity between the two fields.

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