Models of Musical Analysis

Series Editor Jonathan Dunsby

Early Twentieth-Century Music

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Models of Musical Analysis
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Dodecaphony: Schoenberg

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I ORIENTATION

Schoenberg developed the twelve-tone method and wrote music using it immediately following World War I in the midst of the intense turmoil and trauma of Austrian defeat. In Austria, more than in any country except perhaps Russia, the war brought a drastic break with nineteenth-century social, political and cultural institutions, a break which the long rule of the Habsburgs and the stable ascendancy of the bourgeoisie only intensified. By the turn of the century, the bourgeoisie had come to dominate Austrian social and cultural institutions, especially in Vienna, and had created a society that cultivated stability above any other values. Bourgeois life tended to affirm disciplined conformity, good taste guided by tradition, reason and belief in orderly social progress. In the decade preceding the war, to be sure, eloquent voices of dissent might occasionally be heard, and some Austrians were not without premonitions of unknown social horrors. Writers such as Karl Kraus and Stephen Zweig, the poets of the *Jung Wein* and the artists known as the Expressionists all attacked the constraints of bourgeois life and art. But few were prepared for the upheavals, hardships and discontinuities of defeated Austria.

Defeat produced despair and cynicism in some, but others recognized in broken cultural continuity an opportunity for the humanist renaissance that inspired at least two major works of cultural history: Allan Janik and Stephen Toulmin's *Wittgenstein's Vienna* and Carl I. Schorske's *Fin-de-siècle Vienna*.[1] 'Hell lay behind us', Zweig wrote in his memoirs, 'What was there to frighten us after that! Another world was about to begin'.[2] The peace treaty of Versailles effectively dismantled the Habsburg Empire. Postwar Austria therefore faced the task of rebuilding its polity. A constitution had to be framed, a parliament established and an effective system of social democracy put in place. The times seemed to demand fresh thinking, bold innovation, new institutions freed from the dead weight of the past. This spirit of construction, self-determination and independence extended to the arts as well. By the turn of the century bourgeoisie had largely replaced aristocrats as patrons of the arts, but the arts themselves continued as before. It took war and its aftermath to produce a radical break with earlier styles and conventions and inaugurate in all the arts a period of intense innovation. Poetry, literature, film, painting, architecture and music all showed concentrated technical experimentation. Artists shed many of the preoccupations and doubts that characterized the prewar years, and a progressive attitude prevailed, as well as a general sympathy towards artistic diversity. With so much to be accomplished, so little taken for granted or exempt from challenge, artists felt encouraged to strike out and validate their own experimental paths.[3]

In this particular cultural milieu, Schoenberg decided to formalize and adopt a new method of composition – radically new even though he claimed to have struggled with its conceptual ingredients since before World War I:

> After many unsuccessful attempts during a period of approximately twelve years, I laid the foundations for a new procedure in musical construction which seemed fitted to replace those structural differentiations provided formerly by tonal harmonies. I called this procedure *Method of Composing with Twelve Tones which are Related Only with One Another*. This method consists primarily of the constant and exclusive use of a set of twelve different tones.[4]

This matter-of-fact account of an autonomous decision to proceed with the twelve-tone method perhaps reflects an objectivity attained only after the fact. For the nature of Schoenberg's artistic decision – its rejection of the expressive forms and technical means that mark his earlier, also revolutionary atonal style – resonates so strongly with postwar developments in other artistic fields that it must reflect Schoenberg's own engagement with, his own constructive response to, the tumultuous social and cultural upheavals of the time.

Schoenberg's later writings contain barely a hint that he ever questioned his decision to adopt the twelve-tone method, and from 1923 until his death in 1950 he composed almost exclusively with it, resurrecting his earlier chromatic and atonal

styles only infrequently. Schoenberg asserted, in his 1934 lecture 'Composition with Twelve Tones', that the twelve-tone method resolved problems of brevity that he had not managed to overcome in atonal forms.[5] In other words, he identified generating extended forms as the twelve-tone method's decisive capacity. Perhaps it was this as-yet unproven potential that prompted in 1921 the famous remark to Josef Rufer that he had 'made a discovery which will ensure the supremacy of German music for the next hundred years'.[6] Towards the end of his life, his claims for the twelve-tone method became no weaker or less confident: 'Forty years have since proved that the psychological basis of all these changes was correct. Music without a constant reference to a tonic was comprehensible ...'[7] Schoenberg never wavered in the conviction that the twelve-tone method was born of artistic necessity, that it represented the inevitable culmination of the highly chromatic and atonal styles that had flourished before World War I.

This assessment of the method (and of Schoenberg's music that embodies it) has never been universal or even general among musicians, critics and composers, either during his lifetime or after. In fact, throughout his career he suffered criticism the unanimity and virulence of which is probably unmatched among twentieth-century composers (fist-fights after concerts, for example, or reviews printed in the crime columns of the Vienna press). Some of this virulence subsided after Schoenberg went to the United States in 1933. In Europe he had been branded as 'The Twelve-Tone Constructor', 'The Atonalist'. In the United States his works were no longer attacked because they were not performed, but he himself enjoyed – or rather suffered – public attention as a theoretician rather than as a composer. Only at the end of his life did the twelve-tone method and Schoenberg's achievement in it enjoy an enthusiastic re-evaluation and development by other composers.

While works using the twelve-tone method were rarely performed until after World War II and therefore unfamiliar to the general public, composers had begun to appreciate the flexibility of the method through the highly varied twelve-tone styles of such proponents as Webern, Berg, Krenek, Casella and Dallapiccola. But the fresh interest accorded twelve-tone and more general serial techniques after World War II resulted directly from the International Summer Course for New Music established at Darmstadt, Germany, in 1946 in order to expose German composers to modern achievements that had been denied or denigrated by the Nazis. Postwar interest by distinguished composers such as Boulez, Stockhausen, Nono and Berio steadily extended serial techniques to musical domains other than pitch (for example, rhythm, articulation, dynamics and register). These same composers had become disenchanted with their serial experiments by 1956, but curiously, and perhaps significantly, it was Webern's music, and not Schoenberg's, that had served as their model. Even those who advocated serial procedures after the war often found Schoenberg's serial rigour uncongenial.

The general nature of the postwar criticism of Schoenberg deserves attention, for it both highlights the compositional issues that made Schoenberg's music difficult to penetrate and explains why even now composers and critics disagree on his place in the history of twentieth-century music. I hope the analysis I shall develop of Schoenberg's *Klavierstück*, op. 33b, will show that what many have regarded as unresolved problems in his method are in fact its most sophisticated resources.

Schoenberg's postwar critics have identified two apparent problems in his twelve-tone method or two discrepancies between his music and the claims he made for it. The first of these might be called 'the harmonic problem', and the second 'the form problem'. In 'Composition with Twelve Tones', Schoenberg made one claim for his serial method that many composers and critics have thought unjustified: not only that the melodies of his music were derived from the basic set, but also that 'something different and more important is derived from it with a regularity comparable to the regularity and logic of [tonal] harmony'.[8] And he goes on to claim, 'The association of tones into harmonies and their successions is regulated (as will be shown later) by the order of [the pitches of the basic set]'.[9] The problem is that Schoenberg never really showed later how a twelve-tone basic set regulates harmonies and their successions, a failure that critics have taken to signal either irresolution in Schoenberg's use of his method, or a failure in the method itself. The tonal system, critics have argued, orders and integrates both horizontal and vertical dimensions of a piece of music, but the twelve-tone system can order only a single dimension and consequently, in itself, cannot produce an integrated musical texture. In this view, Schoenberg's twelve-tone pieces contain many harmonic events unrelated to the basic set. They therefore fail to justify his claim that the twelve-tone row regulates both harmonies and their successions, and they suggest that the method itself is not really comparable with tonal harmony, not a rigorous and radical new practice, but a curious oddity of twentieth-century modernism.[10]

The second apparent problem, 'the form problem', has been most forcefully diagnosed by Pierre Boulez. In an essay called 'Schoenberg is Dead', published in 1952, one year after Schoenberg's death, and in several later writings, Boulez attacks what he views as major shortcomings in Schoenberg's application of his own method.[11] These criticisms reveal, in turn, why Webern's serial music, rather than Schoenberg's, served as a model for those at Darmstadt who sought to extend serial techniques. Boulez concentrates on the potential of the serial method to sustain extended forms comparable with those of tonal compositions. Against the earlier view that Schoenberg went too far in trusting to a method that lacks structural principles comparable with those of tonal harmony, Boulez argued that Schoenberg did not go far enough. Schoenberg failed to explore the potential of the twelve-tone method to generate its own forms, but rather imposed on his new method

inappropriate, ready-made tonal forms, such as sonata form in his quartets or the Baroque dance forms of op. 25.

> The pre-classical and classical forms ruling most of his compositions were in no way historically connected with the twelve-tone discovery; the result is that a contradiction arises between the forms dictated by tonality and a language [the twelve-tone method] of which the laws of organization are still only dimly perceived. It is not only that this language finds no sanction in the forms used by Schoenberg, but something more negative: namely, that these forms rule out every possibility of organization implicit in the new material.[12]

Boulez complains further of Schoenberg's use of 'clichés typical of a romanticism at once ostentatious and outmoded': particularly accompanied melody, counterpoint based on principal and subsidiary voices (*Hauptstimme* and *Nebenstimme*), rhythmic structure based on strong and weak beats, false appoggiaturas, broken chords and repetitions. These complaints lead to the conclusion that Schoenberg's twelve-tone music did not make a clear break with tonal principles, as Schoenberg always claimed it did, because it maintained melody, harmony and counterpoint as separate functions. The irony in Boulez's attack – that even 'though Schoenberg's work is essentially experimental, it lacks ambition'[13] – is that throughout the 1920s and 1930s Schoenberg issued statements (some quoted above) showing him to be ambitious precisely where Boulez would find him timid: in developing the twelve-tone method's potential for extended forms.

Many would agree in identifying Schoenberg as the most influential composer of the twentieth century (rivalled only by Stravinsky), but persistent and largely unanswered complaints about twelve-tone harmony and form have resulted in radically different assessments of the historical legacy of the twelve-tone method and of Schoenberg himself. Two representative accounts will illustrate this predicament, and I hope will explain why any analysis of Schoenberg's twelve-tone music – no matter how elementary – must address forthrightly the issues of twelve-tone harmony and form.

The first account comes from an exemplary book on twentieth-century music by Bryan Simms, who reaffirms much of Boulez's earlier indictment. Simms argues that the upheavals of World War I marked the *end* of musical progressivism for Schoenberg, who afterwards only consolidated and systematized the compositional advances of the preceding decades. Schoenberg's return to conventional, tonal forms after 1921 represents retrenchment for Simms, who argues that, after more than 60 years,

> it is now clear that musical style has not unfolded with the predictability that [Schoenberg] anticipated. The [twelve-tone] method unquestionably produced masterpieces by European composers between the world wars, and ... by several Americans before and after World War II.... But the evolution of style has since led composers on new paths, pushing 12-tone composition, at least for the time, into the background.[14]

The events of the same period call forth the opposite judgement from the eminent composer Charles Wuorinen,

who with Stravinsky and Milton Babbitt, has been one of the principal proponents of serialism in America. For Wuorinen, 'there are in fact only two principal systems in Western music: the tonal and the 12-tone systems'.[15] In his view, the tonal system was 'replaced ... by the 12-tone system, first initiated by Schoenberg, and subsequently developed into a world of chromaticism extending far beyond the domains originally envisioned for its use'.[16] The expansion of serial procedures after World War II is not a failed experiment, but a successful generalization of the concept of the twelve-tone set: 'sets become more global in their organizing power, more abstracted and general, and broader in the domain of their compositional influence'.[17] Where Simms sees recent trends towards highly chromatic music as an implied rejection of serial techniques, Wuorinen believes that it could not have been conceived except for the twelve-tone method which produced a more generalized principle of ordered interval succession. And this achievement holds promise for the future:

> If the principle of ordered interval succession becomes a sufficiently generalized generator of form, then (as is already the case in some 12-tone music) the principles of pitch organization derived from interval content [that is, principles derived from the tonal system] ... can be reintroduced into what is basically order-determined music. This appears to be the direction of highly chromatic music of the present day.[18]

These radically opposed, yet representative evaluations reach back as far as the innovations of 1920 and extend to the most recent developments in twentieth-century composition. Perhaps the irreconcilability of these received opinions has helped in the last decade to prompt an intense re-evaluation of Schoenberg's music, a re-evaluation that stresses his techniques for structuring twelve-tone harmony and form. The following analysis of the *Klavierstück*, op. 33b, aims to suggest some of the fruits of this re-evaluation and begins with the conviction that harmony and form represent the crucial issues for understanding Schoenberg's twelve-tone music.

2   METHOD

To bring these issues into sharper focus, we must return to 'Composition with Twelve Tones' to reconsider how Schoenberg himself conceived of the twelve-tone method and its basic elements. He begins quite simply by defining the basic set and describing its function:

> This method consists primarily of the constant and exclusive use of an ordered set of twelve different tones. This means, of course, that no tone is repeated within the series and that it uses all twelve tones of the chromatic scale, though in a different order.... Such a basic set (BS) consists of various intervals.... The association of tones into harmonies and their successions is regulated ... by the order of these tones. The basic set functions in the manner of a motive. This explains why such a basic set has to be invented anew for every piece. It has to be the first creative thought.[19]

Example 4.1 Basic set with three transformations

An example of a basic set follows with an explanation of how to derive from it three additional transformations (which he terms the retrograde set, the inversion and the retrograde inversion).

Example 4.1 gives the basic set (P) for op. 33b with its three transformations, using Schoenberg's notation as in 'Composition with Twelve Tones'. The example shows that one obtains the retrograde of a basic set (RP) by reversing the order of its pitches – that is, beginning with its twelfth pitch and proceeding in reverse order to the first. The inversion (I) of the basic set is derived by inverting each of its successive intervals about some fixed pitch; in example 4.1, the fixed pitch is the first, B♮. Unlike the retrograde, the inversion associates new pitches, but the exact succession of intervals in their inverted form remains constant. The retrograde inversion (RI) simply reverses the order of the inversion – that is, by reading the inversion from right to left.

Transposition, Schoenberg continues, yields a total of twelve forms (eleven plus the original) of each of the four transformations of the basic set. One can derive by transposition twelve 'prograde' forms of the basic set, by beginning on the twelve available pitches of the chromatic scale. Similarly, there are twelve retrograde forms, twelve inversions and twelve retrograde inversions, giving a total of 48 available forms of a single basic set.

In its simplest formulation, these set-forms represent the essential elements of the twelve-tone method as Schoenberg presents it in his lecture-manifesto. And, in most of Schoenberg's twelve-tone compositions, a single basic set and its various transformations can in fact account for all pitches. But such an account achieves only the most rudimentary kind of analysis, analogous perhaps merely to identifying the keys and melodies of a tonal piece. To proceed further, we need a more precise definition of the basic set itself and a clearer conception of what Schoenberg meant by twelve-tone harmony. As will become clear, the ambiguity inherent in 'Composition with Twelve Tones' explains much of the later confusion that has surrounded the problems of twelve-tone harmony and form.

Schoenberg consistently describes a basic set as a succession of intervals rather than as a series of individual pitches. He stresses that each tone does not function independently, since each 'appears always in the neighbourhood of two other tones' – that is, each functions only in relation to its adjacent pitches.[20] He makes clear that he has included all twelve pitches in the basic set so that no single pitch is repeated more frequently than any other and all pitches are equally emphasized. In naming his new technique 'Method of Composing with Twelve Tones which are Related Only with One Another' he indicates that the twelve tones are mutually dependent and, most important, that they are perceived primarily in terms of each other. It is thus misleading to conceive of the basic set as a series of twelve ordered pitches. Rather, it is primarily a series of intervals set forth by twelve ordered pitch-classes.[21]

According to Schoenberg, the intervals of the basic set delineate all the twelve-tone harmonies for a given piece. But he asserts that listeners will recognize a twelve-tone harmony regardless of the internal ordering of its pitches. Because musical ideas are recognizable in inverted and retrograde forms, the identity of a musical idea or harmony is determined by the absolute relation of its elements – that is, by its total intervallic content and not merely by a single ordering of its pitches.[22] Schoenberg also states that, while the pitches of the basic set usually occur in their original order, a similar restriction need not apply among its partitioned segments. Thus several examples in 'Composition with Twelve Tones' use a basic set that is partitioned into three tetrachords, and the tetrachords themselves need not occur in order, but rather function as if they were independent small sets. In other words, the harmonies of the basic set do not have to occur in a fixed order, but can function independently. (The importance of this last feature will become evident in example 4.2.) To summarize: first, the basic set is best considered as a group of harmonies defined by an ordered series of intervals; second, these harmonies are identified primarily by their *total* intervallic content, not merely by a single series of pitches; and third, when partitioned, their segments can function as independent small sets.

A final property of the basic set, as Schoenberg conceived it, is that its harmonies need not be restricted to a fixed pitch-class content. 'Composition with Twelve Tones' does not state this property explicitly, but strongly implies it in its

Figure 4.1 Combinatorial property of basic set

(a) Vertical aggregates:

P$_{11}$: 11 1   5   3   9   8   6   10 7   4   0   2

I$_4$: 4   2   10 0   6   7   9   5   8   11 3   1

_____/ _____/
          aggregate   aggregate

(b) Horizontal aggregate:

P$_{11}$ RI$_4$

11 1   5   3   9   8   6   10 7   4   0   2 // 1   3   11 8   5   9   7   6   0   10 2   4

_____/
                          aggregate

discussion of how twelve-tone harmony works, as well as in the musical examples it provides. For instance, an early version of 'Composition with Twelve Tones' ambiguously redefines what constitutes a harmony under the new method:

> ... the concept whereby the vertical and horizontal, harmonic and melodic, the simultaneous and the successive were all in reality comprised within one unified space. It follows from this that whatever occurs at one point in that space, occurs not only there but in every dimensional aspect of the spatial continuum, so that any particular melodic motion ... will not only have its effect upon the harmony, but on *everything* subsequently that is comprised within that spatial continuum.[23]

Schoenberg evidently does not conceive of harmony as merely a vertical event — pitches sounding simultaneously — but asserts that melodic events — pitches sounding successively — also have harmonic implications. A legitimate harmony comprises all pitches, both simultaneously and successively, that are temporally associated or, as he describes it, 'comprised within the same spatial continuum'. But what defines this spatial continuum? What sets its bounds? A brief example from op. 33b will clarify this obscure invocation of what Schoenberg later called 'multi-dimensional musical space', and will show precisely its importance both for harmonic structure and for form. But the example requires that first I review one further property of hexachords that Schoenberg discusses in 'Composition with Twelve Tones', one that is now usually termed 'combinatoriality'.[24]

In some basic sets, when an operation (transposition, retrograde transposition, inversion or retrograde inversion) is performed on the first hexachord, the result is a new

hexachord which includes none of the pitches of the original. Together the two hexachords produce an 'aggregate' whose combined pitch-class content is the same as the universal set of twelve pitch-classes. This property of 'combinatoriality' depends on segmental or hexachordal pitch-class content, but not at all on the ordering of elements within those segments. It provides a further means of ensuring the constant recycling of the twelve pitch-classes, in addition to that already provided by the repetition of the basic set itself.

Figure 4.1 illustrates hexachordal combinatoriality in op. 33b's basic set. I represent the basic set in numeric rather than musical notation, as in example 4.1, because we must now treat the row as a series of *pitch-classes* rather than as a series of specific pitches. Row forms are conventionally labelled by the operations P, RP, I and RI, followed by an integer that represents the first pitch-class of the designated row form, whether prograde or inverted. Pitch-class integers remain fixed; they do not shift. (The twelve pitch-classes are designated by the integers 0 through 11. Pitch-class 0 refers to all notated pitches C, B♯ and D♭♭; pitch-class 1 refers to all notated pitches C♯, D♭ and B×, and so on.) Figure 4.1, then, presents the initial form of op. 33b's basic set; it begins on B♮ and is therefore labelled P$_{11}$. Below it appears the inversion of the prograde form that begins on E♮ — that is, I$_4$. Notice that when the first hexachord of P$_{11}$ is inverted around pitch-class 11 and then transposed up five semitones (that is, by interval-class 5), a new hexachord results which excludes the pitch content of the first. This new hexachord is, of course, the first hexachord of I$_4$, and since the two hexachords do not

overlap in pitch content (the initial hexachords of P_{11} and I_4) they produce an aggregate which contains all twelve pitch-classes. (The same is true for the second hexachords of P_{11} and I_4.) Aggregates can unfold either vertically, as in figure 4.1a, or horizontally, as in figure 4.1b (the formation of the aggregate here requires one row form to unfold in retrograde); the former configuration generates two aggregates vertically, where the latter allows only one horizontally.[25] As we shall see, Schoenberg uses both horizontal and vertical aggregates throughout op. 33b to create additional dimensions of harmonic structure.

One example from op. 33b will clarify Schoenberg's concept of 'multi-dimensional musical space' and his typical method of structuring twelve-tone harmony, as well as illustrate why harmonies of the basic set should be defined principally by their *total* intervallic content rather than by a single ordering of intervals or pitch-classes. Example 4.2 shows the third phrase (bars 11–16) of op. 33b, which unfolds the successive row forms P_{11} and RI_4. (Order numbers 1–12 mark the first occurrence of successive pitches in each row form, but not later occurrences.) As everyone immediately hears, this phrase represents a kind of varied repetition of op. 33b's opening, differing only in the inverted contour of its cantabile melody and in the pitch repetition and registral expansion of its accompaniment. As in the opening, these row forms unfold what Schoenberg regards as an ordered presentation of the basic set. The partitioned dyads in the upper voice seem to enter too late with respect to those in the bass (for example, in bar 12 the pitch marked by order-number 5 in the left hand enters before that marked by order-number 4 in the right hand), but this kind of configuration is typical of Schoenberg's style and exemplifies the feature mentioned above, namely his use of partitioned segments as 'independent small sets'. Analysis of the harmonic structure of this phrase, however, will reveal criteria governing *how* these partitioned segments are used independently, criteria that Schoenberg only hinted at in his vague invocation of 'multi-dimensional musical space'.

The phrase occurs in two connected dimensions of harmonic structure, as indicated by brackets in figure 4.2. (Order numbers indicate the relative position or register of the pitches that make up the two principal voices – melody and accompaniment – marked by separate stemming in the score.) What we can call the 'primary dimension' includes the entire phrase and simply reproduces the ordered, successive pitches of P_{11} and RI_4. The primary harmonic dimension, in other words, contains contiguous elements of the basic set and is bounded within each of its ordered statements. The 'secondary dimension' spans each individual row form and represents the tetrachordal harmony of the melody (marked pitch-class set 4–2) and the complementary eight-note harmony of its accompaniment (marked pitch-class set 8–2).[26] Notice that the tetrachordal harmony of the melody contains pitches non-adjacent in the basic set (order-numbers 3, 4, 9, 10), but this

harmony is nonetheless equivalent to a linear segment of the basic set (order-numbers 6, 7, 8, 9). (Linear segments are marked on the basic set that appears at the bottom of figure 4.2, and 'equivalent' here means that they are not identical in pitch content, but are related by transposition or inversion, or both.) In other words, the melody of bars 12–13 unfolds a tetrachord containing pitches with the non-successive order numbers 3, 4, 9 and 10, but this harmony is equivalent to (being a transposition of) the tetrachord with the successive order numbers 6, 7, 8 and 9. Hereafter, 'secondary harmonic sets' refer to pitch-class sets such as these which structure secondary harmonic dimensions. Secondary harmonic sets can be derived from one or more forms of the basic set and always have non-successive order numbers, but are nonetheless equivalent to linear segments of the basic set. In bars 12–13, the secondary harmonic tetrachord (the melody, pitch-class set 4–2) contains pitches in the same order as the equivalent tetrachord in the basic set, but such identical ordering is rare. It does not occur, for example, in the secondary harmonic dimension that structures the accompaniment in bars 12–13.

There are a number of reasons why the harmonies of a basic set must include not only all of its linear segments but also the complements of these segments – in this example, why both the linear segment 4–2 and its complement pitch-class set 8–2 should be regarded as harmonies of the basic set. Pitch-class set 8–2 has order numbers 1, 2, 3, 4, 5, 10, 11, 12 and therefore represents a linear segment only if the basic set is taken as a kind of loop, so that order-numbers 12 and 1 are successive order numbers. The most important reason for accepting these round-the-corner segments as harmonies of the basic set can be inferred from 'Composition with Twelve Tones'. Here Schoenberg refers to the 'separate selection of the tones for their respective formal function, melody or accompaniment', thereby suggesting that pitches of the basic set function within one of two principal harmonic dimensions, as part of the melody or as part of the accompaniment.[27] Since any linear segment of the row can form the principal voice, the accompaniment always contains the complementary set, a set frequently composed of non-adjacent linear segments from both ends of the row. Thus, because complementary sets usually delineate the two principal harmonic dimensions of Schoenberg's music, we must regard as harmonies of the basic set the complements of all its linear segments. This conclusion is valid, of course, only if we accept his claim that a single basic set regulates all harmonies and their successions and can thereby produce an integrated musical texture.[28]

We can see now that, no less than the melody, the accompaniment in example 4.2 comprises a secondary harmonic dimension. But the internal structure of this secondary dimension serves to illustrate further a crucially important feature – that harmonies defined as equivalent to those of the basic set need not maintain the same internal ordering of their pitches. Notice that the accompaniment in each row form unfolds two tetrachords (pitch-class sets 4–11 and 4–24), each

Example 4.2 Op. 33b, bars 11–16

Row forms and order numbers marked

Figure 4.2 Order-number transcription with secondary harmonic sets

(P_{11})

(RI_4)

containing non-adjacent pitches in the basic set (order numbers 1, 2, 5, 6 and 7, 8, 11, 12). Both of these tetrachords are equivalent to linear segments of the basic set and thus represent secondary harmonic sets, but these sets, unlike the melody, do not duplicate the ordering of the basic set. The example demonstrates, then, that secondary harmonic sets, though equivalent to linear segments of the basic set, need not include the same succession of intervals. Example 4.2 also illustrates Schoenberg's use of an aggregate to provide an additional dimension of harmonic structure; here the aggregate links together the final hexachord of P_{11} with the initial hexachord of RI_4 (marked in figure 4.2). The aggregate, along with the complementary sets 4–2/8–2, thus comprises two secondary dimensions of harmonic structure derived from the basic set that serve to connect non-adjacent elements within and between successive row forms.

This example shows how Schoenberg could legitimately assert that a single twelve-tone row can integrate all harmonic and melodic dimensions of a composition, and also shows the rudimentary techniques implied by that assertion. Many composers and scholars have misunderstood, however, and complained that because pitches adjacent in the melody are not adjacent in the row Schoenberg imposed an extrinsic harmonic structure on his theme. The row itself must therefore be insufficient to generate a complete musical texture. Boulez never mentions this specific example, but it is easy to infer from his general argument what he would say. He would complain that Schoenberg's attempt to combine twelve-tone serialism with a typically tonal texture of theme and accompaniment led to arbitrary and contradictory restrictions. Boulez might argue, for instance, that the predominantly crochet pulse of the melody serves to separate it rhythmically from the faster accompaniment, but also thwarts a rhythmic and harmonic structure that is uniquely serial. Our analysis shows, however, how Schoenberg's multiple dimensions of harmonic structure delineate a four-bar phrase subdivided into two two-bar segments of equal length. The form and structure of this phrase thus is not an arbitrarily imposed tonal texture, but rather emerges from twelve-tone techniques alone.

Example 4.2 and figure 4.2 conveniently illustrate, then, three principles of twelve-tone harmonic structure that are worth reiterating. First, twelve-tone harmonies need not be simultaneous: they do not occur only in the vertical dimension. In 'two-or-more-dimensional space' no categorical distinction exists between the vertical and the horizontal, and harmonies are defined as pitches occupying the same 'spatial continuum'. In this example this concept allows Schoenberg to regard a tetrachord unfolded by the melody as a harmonic entity, even though its elements unfold successively.

Second, a single harmonic event necessarily affects *more* than one dimension. In this phrase, for instance, each pitch functions simultaneously in at least two different harmonic dimensions. This principle is confirmed by statements in 'Composition with Twelve Tones'.

Any particular melodic motion – for instance, a chromatic step – will not only have its effect upon the harmony, but on everything subsequent that is comprised within that spatial continuum.... This circumstance ... enables the composer to assign one part of his thinking to ... the vertical, and another in the horizontal.[29]

Because, in Schoenberg's view, musical ideas necessarily affect both vertical and horizontal dimensions, a composer must structure both simultaneously, and not merely attend to the unfolding of the row.

Third, and most important, the order of the twelve pitch-classes defines the harmonies of the basic set, but it defines them primarily by total intervallic content rather than by pitch-class content. Moreover, these harmonies need not be presented by the same succession of intervals as in the basic set, that is, the internal ordering of their pitches need not be the same. But because they are related by transposition or inversion or both, their total intervallic content will always be the same. These three principles of harmonic structure provide the foundation for analysing Schoenberg's twelve-tone music. Analysis of a specific piece needs, of course, to consider other essential features, such as motivic structure, rhythm, development and form; but, as I hope the following analysis demonstrates, these features derive from Schoenberg's method of structuring twelve-tone harmony.

3   MODEL

Analysis of a piece of twelve-tone music must begin with the basic set in itself and not in any of its particular occurrences in the piece. Schoenberg asserted that a basic set 'functions in the manner of a motive', and that therefore each piece requires a unique basic set, but these assertions can confuse inexperienced twelve-tone analysts because crucial differences distinguish a basic set from a motif. Most importantly, the basic set determines only those features that pertain both to pitch and to pitch-class relations. That is, the basic set governs how the twelve pitch-classes are used, but, unlike a motif, does not govern features related only to pitch, such as register or motivic contour. The local context in the piece governs these features, but not features that pertain to pitch-class relations which are predetermined and thereby assume greater structural importance. We should try to hear a twelve-tone piece, then, not only in itself, but also in reference to its basic set and to the operations of the twelve-tone system (transposition, inversion and retrogression).

The basic set determines both those features pertaining to pitch and pitch-class relations and the constituent harmonies of the piece. I have already set forth a definition of Schoenberg's twelve-tone harmony and his principle of harmonic structure, but I must emphasize that, while the basic set restricts the harmonies that can structure a piece, it does not determine

which of these the composer actually uses. Schoenberg himself usually limits his structural harmonies to as few as ten or twelve in an entire piece or movement.

Schoenberg's criteria for choosing some structural harmonies from those determined by the basic set can sometimes be guessed from its overall succession of interval classes or from differences among the segments of its principal partitionings (that is, hexachordal, tetrachordal and trichordal). Such guesses may prove erroneous, but often they do reveal general features that convey the temporal unfolding of the basic set or create the piece's form. Op. 33b's basic set provides one such example, for on first hearing several features stand out that later prove crucial to analysis. First, because many of its three-, four- and five-note segments represent whole-tone sets, a whole-tone sound dominates its overall interval-class succession. This feature, however, pertains only to some of the segments derived from the three principal partitionings. Partitioning the set into two hexachords produces two versions of pitch-class set 6–34 – [11, 1, 5, 3, 9, 8] and [6, 10, 7, 4, 0, 2] – the 'almost' whole-tone hexachord that uses five of the six possible tones of a whole-tone scale. Partitioning into three tetrachords also produces predominantly whole-tone sets, since each tetrachord contains at least one three-note whole-tone segment: [11, 1, 5, 3], [9, 8, 6, 10] and [7, 4, 0, 2]. But trichordal partitioning produces a different result: of the four trichords, only the first and last represent whole-tone sets: [11, 1, 5], [3, 9, 8], [6, 10, 7] and [4, 0, 2]. Through this whole-tone feature, then, trichordal partitioning provides for temporal differentiation of the middle of the row from its beginning and end.

What means, if any, has Schoenberg used to differentiate the hexachords and tetrachords with their uniformly predominant whole tones? First, the basic set's two hexachords unfold the interval-class successions [2, 4, 2, 6, 1] and [4, 3, 3, 4, 2] which each contain unique interval classes, that is, ones absent from the other partition. Interval-classes 1 and 6 mark the one hexachord and two occurrences of interval-class 3 mark the other. Unique interval classes similarly differentiate the interval-class succession of the three tetrachords; the first, [2, 4, 2], progresses only by whole tones or their composite intervals, the second, [1, 2, 4], contains the single instance of interval-class 1 and the third, [3, 4, 2], the single instance of interval-class 3. (A listener may perceive this feature initially by hearing the strongest contrast between the first tetrachord, with its emerging tritone between order-numbers 1 and 3, and the last tetrachord, with its major/minor triad spanning order-numbers 9 to 11.) This kind of intervallic differentiation among the basic set's partitions is crucially important for hearing – as well as analysing – op. 33b, for it enables a listener to perceive the temporal progress of the basic set as it unfolds in any of its three principal partitions, even if he or she cannot at any given moment identify its exact transformation (that is, R, I or T).
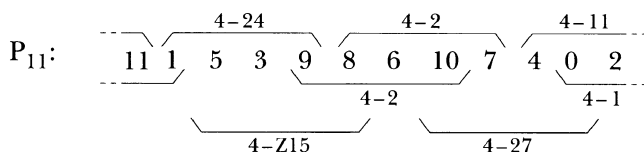
This kind of general observation about the basic set often suggests related issues fruitful for analysis. Here, having observed how Schoenberg uses unique interval classes to differentiate partitions, we might well ask why he simultaneously maintains their uniformity through recurring whole-tone segments, and the question will reveal the use of a secondary harmonic structure such as those discussed in example 4.2. This one relies upon the association of non-adjacent dyads to form harmonies equivalent to linear segments of the basic set itself, and op. 33b's basic set proves to have remarkable properties of this type, which in turn rely upon the whole-tone segments recurring in the row. As figure 4.3 shows, if one partitions the basic set into six dyads, and then associates all pairs of non-adjacent dyads, more than half such associations (six out of ten) produce a tetrachord equivalent to a transposed or inverted linear segment of the row – that is, a secondary harmonic set. This illustrates, then, how analysis of the basic set's interval-class succession and principal partitions can suggest criteria that influence the composer's choice of structural harmonies. Analysis of the music itself would no doubt eventually reveal these criteria, but they may be concealed or emerge only late in the piece. But the issue is not just efficiency: getting the best results for the least analytical labour. The analyst needs to remember that the composer has created the basic set as well as the piece, and in that order.

Figure 4.3 Dyadic partitioning and derivation of secondary harmonies

P_{11}:   11 1   5 3   9 8   6 10   7 4   0 2

Dyads: 1   2   3   4   5   6
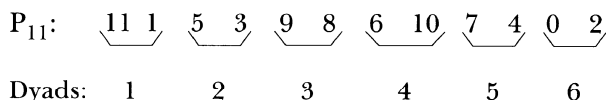
Dyads = Tetrachord

1 + 3 = 4–11   (pcs 8, 9, 11, 1)
1 + 5 = 4–27   (pcs 1, 4, 7, 11)
1 + 6 = 4–1   (pcs 11, 0, 1, 2)
2 + 5 = 4–2   (pcs 3, 4, 5, 7)
3 + 6 = 4–Z15 (pcs 8, 9, 0, 2)
4 + 6 = 4–24   (pcs 10, 0, 2, 6)

P_{11}:   11 1   5 3   9 8   6 10   7 4   0 2

4–24   4–2   4–11

4–2   4–1

4–Z15   4–27

Example 4.3 Principal theme, op. 33b, bars 1–5

Rhythmic analysis

After studying the basic set, a twelve-tone analysis can proceed to the piece's important motifs or themes. In Schoenberg's music these usually appear at the beginning of the piece, or at the beginning of its principal sections. Let us for a moment consider beginnings in general, since they pose problems for composers that are often overlooked by analysts. Risking the obvious, one can advance several generalizations about what an effective beginning does. First, and most obvious, its beginning distinguishes a piece of music from other pieces; it presents features that make a piece itself. Second, a beginning usually implies criteria for inclusion and exclusion. That is, it specifies a compositional method – which techniques are admissible, and which are not – and thereby creates expectations in the listener that have been thought almost to constitute a contract between composer and listener. More specifically, a beginning usually implies rules for prolonging and developing motifs – that is, explicit or implicit modes of continuation. One mark of an effective beginning is the ability to generate continuations particular to the work it introduces.[30]

If we return from the safety of abstraction, Schoenberg's beginnings can be seen to illustrate well these generalizations. First, Schoenberg's beginnings usually set forth the regular ordering of the basic set, and since his method requires that

all a piece's melodies and harmonies derive from this set, his beginnings do introduce the basis of its identity. Similarly, only rarely do Schoenberg's beginnings lack secondary harmonic dimensions that will serve in turn to generate the overall form of the piece. Clear use of secondary harmonic dimensions at the beginning creates expectations about the kind of harmonic structures that will organize and continue the piece. Schoenberg's principal technique for building extended forms – what he terms 'developing variation' – in fact ensures that continuations fulfil the expectations promised by the beginning. In my view, the challenge to the twelve-tone analyst is to arrive at an understanding of how the music works in time on actual listeners. It may help to know how the piece was composed, but that is not the real goal. For these reasons, I want to begin by examining op. 33b's opening section and show how it leads to later continuations, thereby generating form. I will begin with harmonic structure and then move on to rhythmic and motivic structure. The result may seem a lengthy discussion of the piece's opening, but that discussion will be more helpful than any superficial survey. The first nine bars present the basic material that, varied and developed through the piece, creates op. 33b's form.

The form of op. 33b divides into two parts (bars 1–31 and

Figure 4.4

(a) Harmonic analysis (ONs)
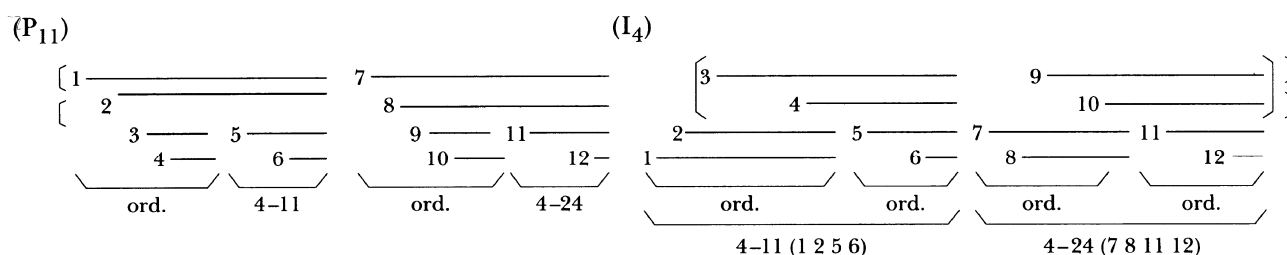
(b) Harmonic analysis (ONs) ♪'s

(c) Basic set (PCs)

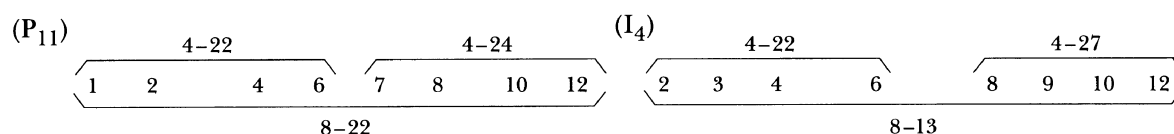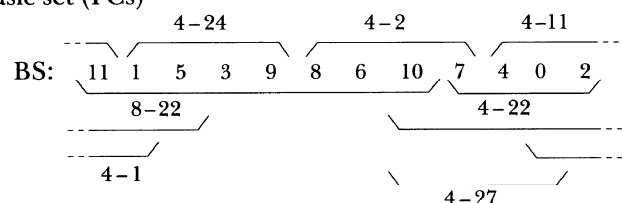bars 32–56), followed by an extended coda-like passage (bars 57–68); only the first part divides clearly into sections (bars 1–18 and bars 19–31). Both parts employ two contrasting themes, the first derived from dyadic partitioning of the basic set and the second from trichordal partitioning. But their contrast extends beyond partitioning, for each uses a unique harmonic structure that Schoenberg varies and develops along with their distinctive rhythms and motifs.

The piece begins with the first theme (example 4.3), whose harmonic structure derives from the kind of properties shown in figure 4.4, and the texture highlights these properties. That is, by placing specific dyads in the right hand against those in the left, Schoenberg associates temporally dyads that are not connected in the row. Notice that, in this phrase, the left and right hands together unfold two ordered forms of the basic set, P_{11} and I_4. (These two row forms are combinatorially related (see figure 4.1) and are the only two used (along with their retrograde forms) in the entire piece.) Thus in the horizontal or primary dimension of the theme, the row is perfectly ordered; but in the vertical or secondary dimension, a kind of temporal re-ordering occurs. The first two pitches of the right hand, for example, are sustained to overlap with the fifth and sixth pitches in the left hand, thus creating the row segment 4–11. As figure 4.4a shows, each of the dyads extracted from the row and put into the melody creates this same kind

of secondary dimension. (In figure 4.4a, b and c and those following I mark only secondary harmonic dimensions; those harmonies that contain only successive order numbers are marked 'ordered'.) One can hardly imagine a texture that would exhibit this dyadic property of the basic set more strongly than this opening phrase.

The principal theme's rhythmic structure depends directly on this secondary or vertical harmonic dimension. To explain this, I need first to analyse its various rhythmic strata and then show how the interaction of these strata creates metre.[31] A general theory of musical rhythm in Schoenberg's music deals with the regular recurrence of related events. Rhythm is not abstract; one must speak of the rhythm of definite events, and those events must be related by similar features or analogous functions. Recurrence establishes a logical class of events in which an occurrence and all recurrences are members, and some criterion must specify this logical class. Criteria can include such features as quality of attack, dynamic level, timbre, and pitch or harmonic function. If events that belong to the same class recur at equal intervals of time, then they define a *rhythmic stratum*; they have a simple periodicity in which each recurrence begins a cycle that ends with the next recurrence. A rhythmic stratum thus contains more than one event; all its events recur at equal intervals of time, and all are characterized by the same criterion. In this example, I

want to deal only with the rhythmic strata created by pitch or harmonic function.

First, the two ordered row forms, P_{11} and I_4, each spanning two bars, comprise the primary harmonic dimension and form a stratum (marked B in example 4.3) in which the recurrence interval is four beats. A second stratum (marked C) derives from the combinatorial property; each of the four successive hexachords spans two beats, or one half-bar, but the pitches contained in the second and third hexachords are identical, thus forming not an aggregate, but a type of pitch or hexachordal palindrome. These held or invariant pitches create a kind of syncopation, shown in stratum C, by the tie that slurs together the second and third minims. Of greater significance are the strata derived from the phrase's secondary harmonic dimensions. Consider, for example, how the secondary harmonic tetrachords discussed above help delineate the stratum marked E. They in fact are essential to this stratum, for the alternation of ordered tetrachords with secondary harmonic tetrachords creates a recurring pattern of durations that recurs every two beats. Moreover, in the second part of the phrase, these secondary harmonic tetrachords make explicit the pattern's two-beat interval of recurrence. Without these tetrachords and the secondary harmonic dimension they create, stratum E would not exist. And without stratum E (as well as stratum D, discussed below), the phrase would lose its duple metre. Any implied duple metre would be quite trivial, for it would derive merely from the hexachordal partitions and their periodic unfolding.

Several other secondary harmonic dimensions, ones that Schoenberg will develop later in the piece, reinforce the duple metre of this passage. Probably the most important emerges from the four melodic dyads in the right hand, creating the effect of a compound melody. The initial pitches of the four dyads, always higher in register, create the tetrachord marked 4–11, a linear segment of the row as well as the segment formed by the association of its first and third dyads (see figure 4.3). Likewise, the four second pitches, always lower in register, create tetrachord 4–1, again a linear segment of the row and the set formed by joining its first and last dyads. This secondary harmonic dimension is crucial to form, since it spans the entire phrase and joins its parts into a whole; its completion, then, creates a twelve-tone analogue to a tonal cadence.

A last harmonic dimension (figure 4.4b) again uses secondary harmonies displayed in figure 4.3. Although covert here, its secondary harmonies become increasingly important later in the piece. At the beginning they form a stratum (D) that reinforces the duple metre of strata B, C and E. Stratum D is formed by each pitch that occurs on the notated quaver pulse; in other words, stratum D contains all pitches except those that fall on the recurring demisemiquaver pick-ups. The secondary harmonic sets structuring this stratum are shown in figure 4.4b. Its successive secondary tetrachords (4–22, 4–24, 4–22, 4–27) form a stratum whose recurrence interval is minims. At the same time, successive tetrachords pair together to form

two eight-note secondary harmonies, 8–22 and 8–13, and thereby create a stratum whose recurrence interval is four beats. The secondary dimensions of this stratum thus reinforce the duple metre established by those of strata C and D.

The secondary harmonic sets of this opening phrase and the duple metre they set forth introduce the principal harmonic and rhythmic features that Schoenberg employs through much of the piece. A third essential feature, motivic contour, can conclude our analysis of the principal theme. No less important than harmony and rhythm, motivic contour is more difficult to analyse. Unlike pitch-class and rhythmic relations, motivic contour does not lend itself to quantification. In Schoenberg's music, the associative and formal power of purely motivic features often seems to increase as they become more elusive, harder to define, as if their richness resides in flexibility or ambiguity. While I argue above that essential differences distinguish a basic set from a motif and that the pitch-class relations determined by the basic set have greater structural importance, I must emphasize that our perception of pitch-class relations, as well as the harmonic structures that derive from them, depends subtly on motivic contour. Op. 33b illustrates how Schoenberg uses motivic contour, first, to contrast the two principal themes, and then, as the piece progresses, to vary and develop their distinctive features – not just separately, but simultaneously. The motivic contours that at the beginning keep the principal themes separate serve at the end to bring them together and emphasize their common structures.

Only recently have analysts begun to investigate how motivic contour functions in twentieth-century music. I cannot offer a thorough discussion of this topic, but can present two tools for analysing motivic contour that prove especially useful in the analysis of twelve-tone music: Contour Adjacency Series and Contour Class.[32] Both are somewhat rudimentary, but do allow one to describe how, and to what degree, distinct contours relate to one another.

A Contour Adjacency Series (CAS) merely describes the ordered series of directional moves up and down (+ , −) in a motif or theme. For example, the CAS for the first hexachord of P_{11}, bar 1, is $< -, +, -, +, - >$ and the CAS for the right hand, bars 1–2, is $< -, +, - >$ (see example 4.4). A CAS disregards immediately repeated pitches, and because it does not indicate the contour relation between non-consecutive pitches, does not indicate non-consecutive repeated pitches. That is, the CAS $< +, - >$ does not reveal whether the third pitch is identical to, or higher or lower than, the first. Thus CAS gives only a blunt description of a series of moves between temporally adjacent pitches.

Nonetheless, CAS can effectively describe a general kind of contour equivalence, one that can even include relations integral to the twelve-tone method itself (such as inversion and retrogression). For instance, if we compare the CASs for the four hexachords of the principal theme (right hand + left hand), we see that none are identical, but that two can

Example 4.4 Principal theme: CAS and CC analysis

Mäßig langsam (♩ = 64)

CAS:	melody (RH)	<-,+,->		<-,+,->	
	accompaniment (LH)	<-,+,->	<-,+,->	<+,+,->	<-,+,->
	mel. + accomp. (RH + LH)	<-,+,-,+,->	<-,-,-,+,->	<+,+,-,-,->	<-,+,-,-,->

CC:	melody (RH)	<3-1-2-0>		<3-1-2-0>	
	accompaniment (LH)	<3-1-2-0>	<3-1-2-0>	<0-2-3-1>	<3-1-2-0>
	mel. + accomp. (RH + LH)	<5-3-4-1-2-0>	<5-4-3-1-2-0>	<0-2-5-4-3-1>	<3-1-5-4-2-0>

be derived from one another: the retrograde of the second hexachord's CAS, < −, −, −, +, − >, produces that of the fourth hexachord, < −, +, −, −, − >. Thus CAS can reveal contour equivalencies among components, as well as provide a means of describing the contour structure they may comprise; in this contour structure, only the second and fourth among the theme's four components are related. Such a structure can be represented as: a–b–c–Rb. But a very different structure emerges if we compare these same four components using the CASs of the right- and left-hand motifs separately. The CAS for the right-hand motif in bars 1–2, < −, +, − >, is identical to that of bars 3–4; and this same CAS also marks all but one

(the third) of the four left-hand motifs. In contrast to the overall CAS, this CAS by hands reveals a highly repetitive structure in which only the third component stands out: a–a–b–a. CAS thus reveals two distinct yet simultaneous motivic structures in op. 33b's principal theme. A complete analysis of the piece will show that Schoenberg most often connects new motifs with earlier ones in ways discernible by analysing CAS. Either the CAS of the earlier motif or a contour structure derived from earlier motifs will recur.

Contour Class (CC) is a more precise tool for comparing motifs because it describes contour relations among all the pitches of a motif, not merely adjacent pitches, and also

indicates repeated pitches. In a CC, o is the lowest pitch, and n–1 (n = the number of *different* pitches in a motif) is the highest pitch. Using integers to indicate overall registral position, a CC shows the relative registral position of a motif's consecutive pitches. For example, the CC of the right hand in bars 1–2 is <3–1–2–0>, whereas the CC of the theme's first hexachord (right hand + left hand) in bar 1 is <5–3–4–1–2–0> (see example 4.4). (If this motif included a repeated pitch, then its CC would show one integer occurring twice.)

Analysis of the principal theme in terms of Contour Class reveals several structures that coincide with some, but not all those revealed by Contour Adjacency Series. For example, the CC of the right hand in bars 1–2, <3–1–2–0>, recurs as the first, second and fourth CC of the left hand's four figures; only the CC of the third figure stands out. The resulting motivic structure, a–a–b–a, is the same as that arrived at through the CAS. CC reveals a second structure in the final four-note segment of each complete hexachord. If we reduce this segment as a four-element CC, a kind of rhyming pattern emerges that associates the endings of the first two hexachords and those of the last two, thus forming a contour structure that divides into two equal parts, a–a–b–b:

<div>

<5–3–4–1–2–0>   <5–4–3–1–2–0>
    <3–1–2–0>   <3–1–2–0>
         a   a

<0–2–5–4–3–1>   <3–1–5–4–2–0>
    <3–2–1–0>   <3–2–1–0>
         b   b

</div>

Like a–a–b–a, this contour structure also appears among those revealed by the CAS for these same hexachords. The CC and CAS of this theme agree in pointing towards the same contour structures and suggest the kind of reinforcement that makes them highly audible. The CAS structure, a–b–c–Rb, which has no CC equivalent, is less perceptible, at least to my ear. CCs and CASs can diverge or coincide. Taken together, the two tools can indicate not only various kinds of contour equivalence, but also the relative importance of the contour structures that result.

This brief discussion will suggest how CC and CAS can reveal several types of contour equivalence, as well as how these types can be related. In analysing Schoenberg's music, the two tools are particularly useful in understanding how the new motifs that often emerge towards the end of a piece are related to earlier motifs. In fact, motivic structures seem often to be subtly planted and left dormant, only to emerge late in the piece as Schoenberg seeks new sources for motivic development. In op. 33b, CC and CAS are particularly helpful because, as I will discuss later, they reveal features common to its two contrasting themes that never become obvious, although they serve later to develop both themes simul-

taneously. Before I take up this topic, however, let me conclude my discussion of the principal theme by explaining how its harmonic, rhythmic and motivic structure serves to develop and delimit the piece's first section (bars 1–18).

Immediately following the principal theme (bars 1–5), Schoenberg presents a second, contrasting theme (bars 5–10), which is followed by a brief transition (bars 10–11) leading into the varied repetition of the principal theme discussed in example 4.2. The harmonic structure of the principal theme and its varied repetition both derive from the association of non-adjacent dyads to form linear tetrachords of the row, those tetrachords shown in figure 4.3. On the surface, Schoenberg varies the principal theme in bars 10–16 by changing the contour and pitch-class content of its melody; inverting the contour of the original melody, bars 10–16 twice join dyads 2 and 5, whereas the original joined them only once. More importantly, the varied repetition, now using the retrograde of I_4, creates an aggregate to join its two forms. The changes in melodic contour are especially interesting here, but I must leave it to the reader to analyse how Schoenberg varies the contour structures revealed by the respective CASs and CCs. I do want to point out one method of variation here, because Schoenberg uses it repeatedly in his music. In the analysis of the opening theme I mentioned that the pitch-class invariants between the final hexachord of P_{11} and the first hexachord of I_4 (bars 2–4) create a pitch-class palindromic that spans the entire phrase. In the variation shown in example 4.2, Schoenberg blocks this palindrome and creates instead a horizontal aggregate joining the two row forms. Notice, however, that the changes in contour in the right hand re-create or transpose the palindrome to the melodic line and that, as in the beginning, the palindrome spans the entire phrase. (Both the CC and the CAS of the melody reveal this palindrome structure.) What sounds in the variation like a short, two-bar change in melodic contour, then, actually re-creates an earlier structure, presented by different means and spanning the entire five-bar theme. This example illustrates one aspect of Schoenberg's technique of developing variation: he seldom varies surface features without also developing structures previously set forth.

Figure 4.5 Melodic palindrome (ONs):

<div>

(RP_{11})   (I_4)

  12   11   6   5   / 5   6   11   12
     4–Z15   4–Z15
                  4–1

</div>

The two-bar phrase that concludes the first section (bars 17–18) can illustrate this same generalization. Initially we might

Example 4.5 Final phrase of first section, bars 17–18

not hear this phrase as a variation of the principal theme since its overall texture and rhythm hardly recall the opening, but important features make it a fitting conclusion to the opening section. If we compare the secondary harmonic tetrachords that structure both the theme and its variation (examples 4.2 and 4.3) with those listed in figure 4.3, we will discover that only pitch-class set, 4–Z15 (formed by joining dyads 3 and 6), does not recur. Precisely these dyads and the resulting tetra-chord 4–Z15 are what Schoenberg uses to structure the melody of the concluding phrase (see example 4.5). Only the contour of this melody recalls the principal theme and suggests a connection to the principal theme. Perhaps even more import-ant, this final phrase uses both a pitch-class palindrome and an aggregate, features that separately structured the theme and its first variation. (The aggregate is self-evident; the pitch-class palindrome arises from the melody's overlapping secondary tetrachords, 4–Z15/4–1/4–Z15, figure 4.5, both of which appear as secondary tetrachords in figure 4.3.) Op. 33b's first section ends, then, just when the dyadic properties that Schoenberg exploits to create the theme's harmonic structure (those shown in figure 4.3) have been fully explored. What determines this major part of the whole form is not just sufficient variation of some idea, but sufficient development of that idea through variation.

Schoenberg builds the form of op. 33b first by presenting two highly contrasting themes, and then by developing their features independently. As shown above, the piece's first section focuses largely on the principal theme; similarly, its second section (bars 19–31) – which rounds out the form's first part – develops the second theme. Analysis of the second section will show that it develops exactly those features of the second theme that contrast most strongly with the first. Two of these features are most important: first, a harmonic structure derived from trichordal rather than dyadic partitioning of the row,

and second, a metre that uses a triple, rather than duple, division of the metrical pulse. (This change, occurring in bar 21, coincides with the notated change from 2/4 to 6/8 metre.) Finally, the second section presents both row forms sim-ultaneously, rather than successively, again according with the second theme and contrasting with the first.

The melody of the second theme (right hand, bars 5–9) unambiguously sets forth a trichordal partitioning of the basic set (see example 4.6). In contrast to the uniform contour of the principal theme (right hand), the contour of the second theme is highly differentiated. Analysis using CAS and CC shows that, in the second theme, Schoenberg varies contour to create a palindrome motivic structure that spans the complete phrase, like those in bars 12–16 and 17–18. Unlike the first theme, the second theme lacks clear secondary harmonic dimensions that would create a distinctive harmonic structure. Its rhythms may seem to continue the duple metre established in the principal theme, but this impression is illusory, since no secondary harmonic dimensions work here to reinforce the duple metre. (The two aggregates that structure the second theme merely divide it approximately in half.) One clue does foreshadow the metre that the second theme will eventually adopt, however. Its palindromic motivic structure creates a rhythmic stratum containing three durations of approximately equal length (see top line of example 4.6), thus anticipating the forthcoming triple metre.

Except for the two vertical aggregates, the harmonic struc-ture of the second theme lacks definition, largely because the repetitive texture of the accompaniment blocks the formation of unambiguous secondary dimensions. But, as in its metrical foreshadowing, the second theme does allude to the distinctive harmonic structure it will eventually assume. Figure 4.6a uses order numbers to show how the successive pitches in the theme's two row forms unfold horizontally. Notice that each

Example 4.6 Second theme, op. 33b, bars 5–10

Melodic
palindrome:

(RI₄)

(RP₁₁)

CAS: melody (RH)	<+,-> a	<-,-> b	<-,-> b	<-,-> b	<+,-> a

CC: melody (RH)	<1-2-0>	<2-1-0>	<2-1-0>	<2-1-0>	<1-2-0>

Figure 4.6a

Vertical hexachords:	RI₄:		12 11 10	9 8 7	6 5 4	3 2 1

RP₁₁: 12 11 10 9   8 7 6   5 4 3   2 1

6-Z36   6-Z3   6-2   6-2

aggregate   aggregate

BS: 11 1 5   3 9 8   6 10 7   4 0 2

6-Z3   6-2   6-Z36   6-2

Example 4.7 Op. 33b, bars 10–11

of the four vertical hexachords always contain, not three pitches from each row as one might expect, but two pitches from one and four from the other:

Figure 4.6b

(RI_4) 12 11   10 9 8 7 6 5   4 3 2 1

(RP_{11}) 12 11 10 9   8 7   6 5 4 3   2 1

This design does create a secondary harmonic dimension comprised of the hexachords 6–Z36, 6–Z3, 6–2 and 6–2. As the piece progresses, precisely this secondary harmonic dimension will serve to differentiate the harmonic structure of the second theme's two vertical aggregates. In the two-bar phrase that immediately follows the second theme (bars 10–11), this distinctive harmonic structure becomes somewhat more explicit. As shown in example 4.7, this phrase reverses the order of the four secondary hexachords alluded to in the second theme (that is, 6–2, 6–2, 6–Z3, 6–Z36), thereby suggesting a long-range palindromic structure with the second theme that sets up the return of the principal theme in bar 11.

To conclude the analysis of the second theme, I want to suggest briefly that, despite the contrast between the piece's two themes and the resulting impression that they lack connection, the second theme nevertheless draws its distinctive motivic shape from components of the principal theme, in fact those that create the retrograde motivic structure discussed above (a–b–c–Rb). If the reader will work out the CAS and CC of the second and fourth hexachords of the principal theme, but partition each into two trichordal components, he or she will uncover the exact motivic structure that generates the melodic palindrome of the second theme. Schoenberg's desire to make this connection audible may, in fact, account

for the abrupt juxtaposition of the two themes, unusual in his twelve-tone works.

To explain how Schoenberg develops his second theme, I need to pause for a moment to qualify some previous assertions, and to introduce one further compositional technique. This added complexity is, I believe, essential to understanding how Schoenberg builds twelve-tone forms beyond their openings. The model analysis I have presented so far cannot reveal how form develops in Schoenberg's works, nor what brings them to a satisfactory conclusion.

I hope the reader has grasped the derivation of structural harmonies from linear segments of the basic set, but Schoenberg also uses a second technique to derive harmonies, not from the internal structure of the basic set, but from invariant segments occurring between specific inversions and transpositions of the basic set. The first technique develops the intervallic structure of the basic set; the second develops a group of specific transformations of that same basic set and elegantly solves the compositional problem of relating the form of a piece to its generative row forms.[33]

These new structural harmonies, termed 'invariant harmonies', almost always emerge in the latter half of long sections or towards the ends of movements. They seem to provide a source for the motivic and harmonic variety needed to generate large-scale form. To put it another way, they keep forms from becoming too repetitive. Schoenberg's technique of deriving invariant harmonies is simple and elegant; he merely joins invariant segments that occur between two row forms in order to create larger harmonies which then serve, like secondary harmonies, to structure secondary harmonic dimensions. Also like secondary harmonies, invariant harmonies are not restricted to a single ordering or a specific pitch-class content. Let me give a simple example of invariant harmonies, and then

proceed to a more complex example in op. 33b. Consider the two forms of a basic set given in figure 4.7, in which some, but not all, of their invariant segments are underlined:

Figure 4.7

P₄: 4 3 1 7 <u>2 5</u> 0 6 9 <u>8 11</u> 10

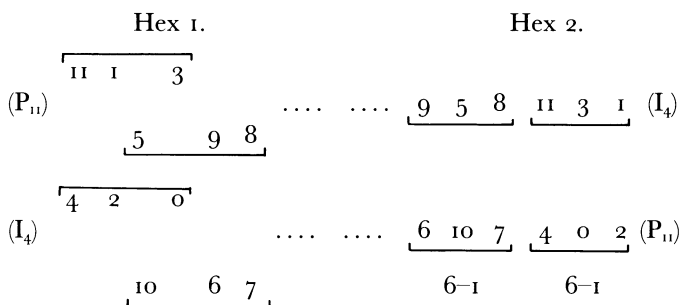P₁₀: 10 9 7 1 <u>8 11</u> 6 0 3 <u>2 5</u> 4

4–28   4–28
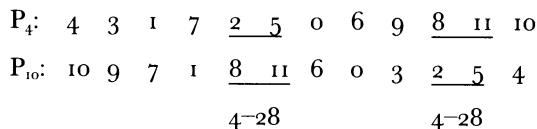
Joining these two invariant segments (pitch-classes 2, 5 and 8, 11) produces the 'diminished seventh' tetrachord, pitch-class set 4–28, which is not a linear segment of the basic set. This new tetrachord is an 'invariant harmony' and can be used, like a secondary harmony, as an unordered pitch-class set to structure secondary harmonic dimensions.

Invariant harmonies, as well as secondary harmonies, serve in op. 33b to develop the second theme beginning in the second section of Part I. But because op. 33b uses only two row forms which do not have any invariant segments (except their combinatorial hexachords), Schoenberg devises an artificial source of invariant segments. These artificial invariants then produce two invariant harmonies, pitch-class set 6–1 [0, 1, 2, 3, 4, 5] and pitch-class set 6–8 [0, 2, 3, 4, 5, 7], which in turn structure many secondary harmonic dimensions.

The invariant harmony represented by pitch-class set 6–1 emerges beginning in bar 21 as follows.[34] The first hexachord of one row form occurs in two separately stemmed voices, each containing three non-consecutive pitches in the row; the three non-consecutive pitches in both voices duplicate trichordal segments of the second hexachord of the other row form. Together, these two invariant trichords create two occurrences of pitch-class set 6–1. Figure 4.8 illustrates this technique:

Figure 4.8

Hex 1.   Hex 2.

(P₁₁) 11 1   3   .... 9 5 8   11 3 1 (I₄)

5   9 8

(I₄) 4 2 0   .... 6 10 7   4 0 2 (P₁₁)

10   6 7   6–1   6–1

The same technique applied to the second hexachord of each row form produces the second invariant harmony, pitch-class set 6–8, as illustrated by figure 4.9.
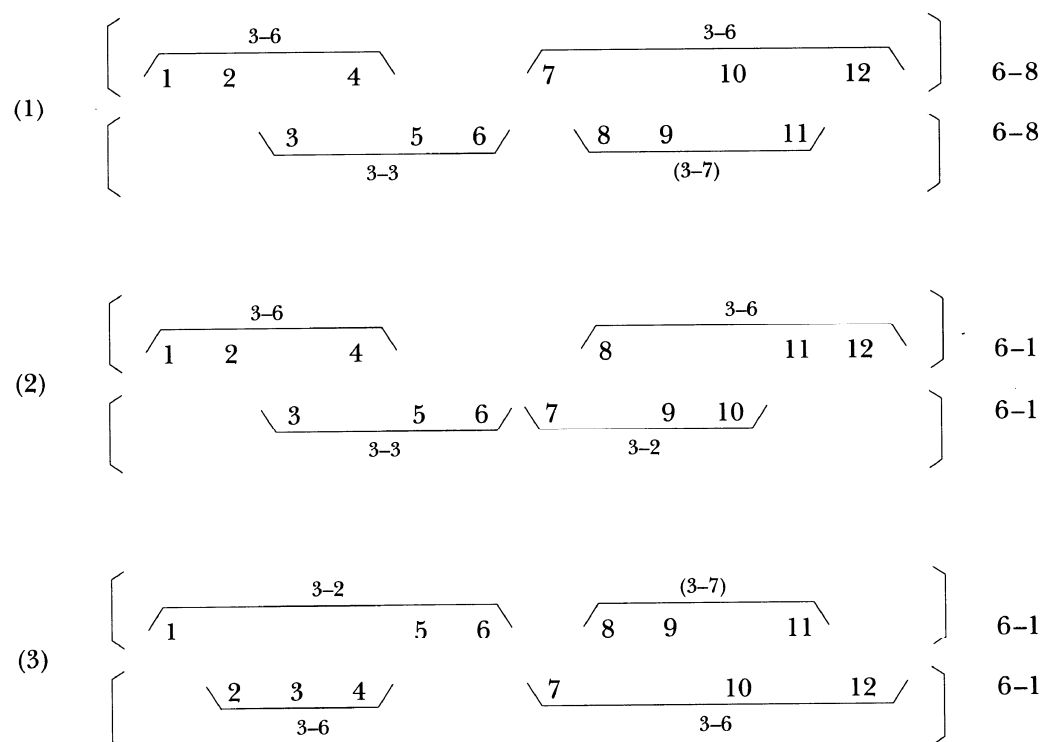
Figure 4.9

Hex 1.   Hex 2.

9   8   11

(P₁₁) 11 1 5 3 9 8 5   3 1 (I₄)

6   7 4

(I₄) 4 2 10 0 6 7 10   0 2 (P₁₁)

6–8
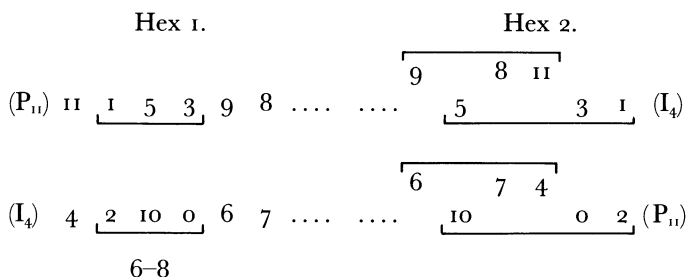
Having derived these two invariant harmonies, Schoenberg then devises three segmentations of the row, each again presented in voices that join three non-consecutive pitches, to produce these two invariant harmonies simultaneously in multiple secondary dimensions (see figure 4.10). (As one might expect, these three segmentations include both of the hexachords noted in the above diagrams.) Among the twelve trichords formed by the separate voices of these three segmentations, all but two represent secondary trichords, that is, trichords equivalent to linear segments of the row. Because these invariant harmonies derive from secondary harmonies, in using them Schoenberg ensures at least two simultaneous secondary harmonic dimensions. We are now equipped to discover exactly how these invariant harmonies and multiple dimensions work in op. 33b.

I shall skip for the moment the short two-bar transition that begins the second section and discuss instead the following two phrases (bars 21–4), in which Schoenberg first develops his second theme by means of invariant harmonies derived from the three segmentations given in figure 4.10. The phrases appear in example 4.8 and an order-number transcription in figure 4.11. The transcription marks with horizontal brackets the trichords of the separately stemmed voices and also shows how the trichords join to form multiple occurrences of the invariant harmonies 6–1 and 6–8. In addition to these two invariant harmonies, one secondary harmony, hexachord 6–2, helps develop the second theme. Schoenberg produces the numerous occurrences of hexachord 6–2 by joining separately stemmed trichords from different row forms. This hexachord is important, since it makes explicit the connection between these two phrases and the second theme. As discussed above, the secondary harmony 6–2 differentiates the harmonic structure of the second theme's final aggregate (see examples 4.6 and 4.7).

Figure 4.11 shows how the development of the second theme employs what we might call a twelve-tone analogue of invertible counterpoint. The separately stemmed trichords move freely through the voices (S, A, T, B), always pairing to form the invariant hexachords 6–1 and 6–8, and the secondary hexachord 6–2. One important exception needs to be explained, for it reveals Schoenberg's overriding interest in devising

Figure 4.10 Three row segmentations for invariant harmonies

long-range secondary dimensions that can join successive row forms into a single phrase. As figure 4.11 shows, the soprano and alto in bar 22 do not project forms of the invariant harmony 6–1, but rather pitch-class set 6–33, a hexachord that is neither secondary nor invariant and receives little emphasis in the piece. We can explain this inconsistency if we analyse the melodic line that spans bars 21–2. In fact, this specific line recalls most strongly the second theme, since both consist of four partitioned trichords unfolded successively. In the second theme these trichords represented an ordered presentation of the row, but here they are all secondary harmonic sets. Nonetheless, all four secondary trichords join to form the secondary harmony 8–22, identical to the first eight-note segment of the row. If bar 22 followed the pattern of bar 21 (forming the invariant harmony 6–1 by switching the trichords in the soprano and alto at the end of bar 22), the melodic line that spans bars 21–2 would not represent a secondary or invariant harmony, and thus no secondary dimension would unify the bars into a single phrase. The melody that spans the following two-bar phrase (bars 22–3) strongly suggests that Schoenberg intentionally structured the melody in this way.

Again using four secondary harmonic trichords, it too unfolds a large secondary harmony, this time pitch-class set 8–1. As in bars 21–2, only this secondary dimension makes these two bars a single phrase.

I now shall return to the two-bar transition that begins the second section in order to explain how it prepares for the development of the second theme, as well as foreshadows the developmental technique employed in Part II. This short transition combines unique features of both themes, but does not yet make use of invariant harmonies. The dyadic partitioning of its four successive row forms recalls the first time, but the trichordal partitioning of its melody, as well as its motivic contour, strongly suggest the second (see example 4.9). Superficially, then, the phrase seems to allude to both themes, but its secondary harmonic dimensions move the phrase away from the first theme and closer to the second, achieving an effect not unlike a tonal modulation between keys. The harmonic structure of the first theme relies principally on secondary harmonic tetrachords, we found, and that of the second on secondary harmonic hexachords. But in this phrase, the dyadic partitions that allude to the first theme do not uniformly

Example 4.8 Part I, section two, invariant harmonies

(a)

Figure 4.11

bars 21–2

bars 23–4

*Trichords joined by contour imitation

Example 4.9 Part I, section two, transition (bars 19–20)

form secondary tetrachords, but rather secondary hexachords (6–Z24, 6–Z46), so that the secondary harmonic structure suggests the second theme. Together with the secondary trichords that structure its melodic line (3–3, 3–3, 3–5, 3–11), this phrase more deeply resembles the second theme and prepares the listener for the intense development of the second theme that follows. At least as important, the simultaneous allusion to both themes points towards op. 33b's second part, where Schoenberg uses a new technique for developing and relating his themes. This technique is crucial to the form of the piece because, by distinguishing the two parts from one another, it makes the second part not just a variation on the first, but a continuation or development; thus op. 33b does not consist of two related parts, but one whole.

Part II introduces no new structural harmonies. As in Part I, the six secondary tetrachords of the first theme (see figure 4.3) and the five secondary or invariant hexachords of the second theme (6–Z3, 6–Z36, 6–2, 6–2) continue to structure multiple secondary harmonic dimensions. But unlike the phrases of Part I, which developed the two themes separately, those of Part II almost without exception develop features of both simultaneously. I only have space to give one example, which I hope will serve the reader as a model for analysing phrase structure throughout Part II.

Part II opens with a five-bar phrase that begins sounding like a varied reprise of the principal theme. After the first three bars, however, the texture slowly transforms, until by the last bar the rhythm and contour of the upper voice clearly recall the second theme. This melodic reference to both themes would remain superficial – merely a clever manipulation of motivic contour and rhythm – were it not for the secondary harmonic dimensions that structure the accompaniment. As example 4.10 shows, the new and rather

dense texture of the accompaniment joins with the melody to form a series of vertical secondary harmonies, all of which strongly recall either of the two principal themes. The phrase begins with two occurrences of pitch-class set 8–12, followed by pitch-class set 8–21, and ends with pitch-class set 8–Z15 – all complements of tetrachordal row segments that have been featured prominently in the principal theme and its variations. (For instance, in example 4.5 notice how pitch-class set 8–Z15 prominently structures the accompaniment against the melodic dyads forming pitch-class set 4–Z15.) The middle of the phrase contains three occurrences of the secondary hexachord 6–2, whose association with the second theme has already been discussed. One last secondary harmony, hexachord 6–34, is the principal hexachord of the basic set. The allusion to both themes in this phrase, then, is more than superficial: it runs also in the deepest levels of harmonic structure.

This double allusion to the two themes becomes a synthesis in the Coda, which I would particularly encourage readers to analyse for themselves. The texture Schoenberg devises for its initial phrase (bars 57–60) brilliantly integrates all of the two themes' principal harmonies: not only the second theme's hexachords 6–Z3 and 6–Z36 along with the large eight-note complements occurring at the beginning of Part II, but also secondary tetrachords set forth by a new melodic imitation between bass and soprano. Regardless how we join the motifs of this complex and elusive texture, we will hear one of the limited number of harmonies that structure the entire piece.

Especially to beginners, serial music can easily seem to have the least unified of all forms – just an arbitrary and unordered set of variations on the series. One way to grasp the aesthetic wholeness of op. 33b, as well as the meaning of Schoenberg's term 'developing variation', is to imagine hearing or playing

Example 4.10 Part two, first phrase, bars 32–6

the two parts in reverse order. Part II would be an incomprehensible jumble. No phrase in Part II (possibly excepting bars 52–4) presents either theme in clear association with 'its' harmonies, as in Part I. No one, I should think, could recognize the form of the piece if confronted with the synthesis before the thesis and antithesis. I have not had space or inclination to present a 'complete' analysis of op. 33b, and to my mind a complete analysis is not one that plods through every bar, but one that grasps the piece's completeness. I have left much for my reader to do in following out and testing this analysis, but I hope I have provided the essential tools.

4 CODA

Some pages ago I suggested that musical analysis aims at understanding how music works on actual listeners, and I should like to conclude by following out an obvious implication of that suggestion. If analysis invokes, not ideal, but actual listeners, then they must listen to actual, not ideal, performers. What can the analyst of op. 33b learn from actual performances? What, in turn, can an analysis like this one teach performers?

Let us focus these questions on the opening phrase of op. 33b and approach them through two well-known recordings that offer an instructive contrast in use of the pedal and articulation of melody and accompaniment, performance issues crucial to how, or if, we hear harmonic structure or metre. The recordings are by Maurizio Pollini and Eduard Steuermann.[35] If you have access to them, listen particularly for differences in pedalling and in projection – or relative balance in tone – between the opening theme and accompaniment. Otherwise, you will have to rely on my description.

However we react to these two performances, some general comparisons seem clear. Pollini produces a much smoother, more beautiful tone. He keeps rhythms fairly regular and clearly separates melody from accompaniment. The melody, in the right hand, sounds decidedly louder than the softer – or 'dolce' – accompaniment. Moreover, the melody is projected by a highly legato touch, reminiscent perhaps of Chopin. Pollini often uses the pedal, probably to ensure an even left-hand legato. The variation of the opening phrase in bar 11 uses much wider and faster leaps in the left hand – and just here the pedalling becomes pronounced and extended, probably to match the left-hand legato of the opening.

By contrast, Steuermann's recording sounds quirkier, even eccentric. Rhythms are jagged and irregular, articulations more varied, and the accompaniment often seems as loud as the melody. There is almost no pedalling. Whatever composer Steuermann's playing might recall, it is certainly not Chopin.

In light of our analysis of this theme, which performance best accords with its harmonic and metrical structure? The answer must be Steuermann's, which our analysis makes more

comprehensible if not clearly superior. By equalizing the tone of the left and right hands, Steuermann makes it easier to hear the vertical tetrachordal harmonies that structure the phrase's secondary harmonic dimensions and are essential to its duple metre. Schoenberg's dynamic markings may themselves suggest this balance: the 'piano' appearing between the systems seems to refer to both parts, and the 'dolce' in the left hand could be achieved other than by a softer dynamic – for example, with contrasting articulations.

The question of pedalling seems even clearer. Any extended use of the pedal emphasizes one harmonic dimension over another, especially when they overlap or intersect, as in this example. Pedalling according to the right hand will obscure or obliterate many of the harmonic dimensions marked in figure 4.4a. Pollini's light pedalling in the first phrase forces him to use more in its variation, where the pedal works against and, to my ear, obscures these secondary harmonic structures.

Eduard Steuermann studied composition with Schoenberg and became a disciple, friend and musical confidant. He gave the first performances of most of Schoenberg's piano pieces (and chamber pieces with piano). Steuermann's rendition of op. 33b is therefore more than just one early performance. It is one the composer is known to have approved; it has something like the status of a document: a sketch, a letter, a performance score.[36] To question whether Steuermann's performance might corroborate our analysis is therefore in a small way to undo some of the breaches that, at least in America, divide our discipline, to play for a moment all three parts in the trio of those whose profession is interpreting music.

NOTES

1 Allan Janik and Stephen Toulmin, *Wittgenstein's Vienna* (New York: Simon and Schuster, 1973); Carl E. Schorske, *Fin-de-Siècle Vienna: Politics and Culture* (New York: Alfred A. Knopf, 1961).
2 Stefan Zweig, *The World of Yesterday: An Autobiography*, (New York: Viking Press, 1943), p. 280.
3 Janik and Toulmin, *Wittgenstein's Vienna*, pp. 239 55.
4 Arnold Schoenberg, 'Composition with Twelve Tones (1)', in *Style and Idea*, ed. Leonard Stein, trans. Leo Black (New York: St Martins Press, 1975), p. 218.
5 Schoenberg, 'Composition with Twelve Tones', pp. 217–18.
6 H. H. Stuckenschmidt, *Arnold Schoenberg: His Life, World and Work*, trans. Humphrey Searle (New York: Macmillan, 1978), p. 277.
7 Schoenberg, 'My Evolution', in *Style and Idea*, p. 88.
8 Schoenberg, 'Composition with Twelve Tones', p. 219.
9 Ibid., p. 219.
10 Scepticism about the harmonic structure of Schoenberg's twelve-tone compositions began during Schoenberg's life and has continued until the present. The following items can be said to represent it fairly: Ernst Krenek, 'New Developments of the Twelve-Tone Technique', *Music Review*, 4 (1943), pp. 81–97; Peter Stadlen, 'Serialism Reconsidered', *The Score*, 22 (1958), pp. 12–27; Seymour Shifrin, 'A Note from the Underground', *Perspectives of New Music*, 1 (1962), pp. 152–3; George Perle, *Twelve-tone Tonality* (Berkeley and Los Angeles: University of California Press, 1977), pp. 23–4.

11 Pierre Boulez, 'Schoenberg is Dead', *The Score*, 6 (1952), pp. 18–22. See also Boulez, *Notes of an Apprenticeship* (New York: Alfred A. Knopf, 1968) and *Conversations with Célestin Deliège* (London: Eulenburg, 1976).

12 Boulez, 'Schoenberg is Dead', p. 20.

13 Ibid., p. 21. See also 'Trajectories: Ravel, Stravinsky, Schoenberg' in *Notes of an Apprenticeship*, pp. 256–8.

14 Bryan R. Simms, *Music of the Twentieth Century: Style and Structure* (New York: Schirmer, 1986), p. 172.

15 Charles Wuorinen, *Simple Composition* (New York and London: Longman, 1979), p. 15.

16 Ibid., p. 3.

17 Ibid., p. 6.

18 Ibid., pp. 8–9.

19 Schoenberg, 'Composition', pp. 218–19.

20 Schoenberg, 'Composition with Twelve Tones (2)' in *Style and Idea*, pp. 246–7. This short essay is undated, but evidence suggests that it was written after 1946 and perhaps as late as 1948.

21 My technical terms and definitions largely follow those of Allen Forte, *The Structure of Atonal Music* (New Haven, CT, and London: Yale University Press, 1973) and Bo Alphonce, 'The Invariance Matrix' (dissertation, Yale University, 1974). *Pitch-class* denotes all pitches of the same relative position in all octave transpositions of a twelve-tone scale. The twelve pitch-classes are designated by the integers 0 through 11.

22 *Total intervallic content* refers to the collection of interval-class representatives formed by taking the absolute value differences of all pairs of elements of a pitch-class set. The twelve intervals reduce to six *interval classes*, designated by the integers 1 to 6 (the interval 11 is designated by interval-class 1, interval 10 by interval-class 2, and so forth). Total intervallic content requires the calculation of intervals between all unordered pairs of pitch-class integers in a given pitch-class set and the conversion of the resulting numbers to interval-class integers, where required. For example, to derive the total intervallic content of a given tetrachord, one must calculate a total of six intervals expressed as interval classes. The total intervallic content can be shown as an ordered array of numerals enclosed in square brackets which is termed the *interval vector*. The first numeral gives the number of intervals of interval-class 1, the second gives the number of intervals of interval-class 2, and so forth. For example, the interval vector [121110] designates a tetrachord that has one interval of interval-class 1, two of interval class 2, and so forth.

23 Schoenberg, 'Vortrag ./ 12 T K / Princeton', ed. Claudia Spies, *Perspectives of New Music*, 12 (1974), p. 83.

24 In 'Composition with Twelve Tones' Schoenberg only discusses hexachordal combinatoriality, even though this property can pertain to trichords and tetrachords.

25 This horizontal aggregate is conventionally termed a 'secondary set', but because this term overlaps with what I call a 'secondary harmonic set' I use 'aggregate' to refer to both types (that is, horizontal and vertical).

26 See chapter 6.

27 Schoenberg, 'Composition with Twelve Tones', p. 234.

28 For a more complete discussion of the reasons why we must regard as harmonies of the basic set the complements of all its linear segments, see my *Schoenberg's Twelve-Tone Harmony: The Suite Op. 29 and the Compositional Sketches*, Studies in Musicology, ed. George Buelow (Ann Arbor, MI: UMI Research Press, 1982), pp. 9–11.

29 Schoenberg, 'Vortrag / 12 T K / Princeton', p. 88.

30 For a more extensive discussion of how beginnings work in Schoenberg's twelve-tone music, see my 'A Theory of Twelve-Tone Meter', *Music Theory Spectrum*, 6 (1984), pp. 14–51.

31 I have presented here only a rudimentary description of metre in Schoenberg's twelve-tone music; for a more thorough discussion, see my 'A Theory of Twelve-Tone Meter'. The reader should not assume that metre structures the twelve-tone music of composers such as Webern and Berg. Rather, it seems that each devises unique methods for structuring rhythm. This apparent lack of consensus, however, should not discourage the reader from trying to answer how rhythm works in twelve-tone compositions.

32 For a fuller discussion of these analytical tools, as well as an original and important discussion of contour in Schoenberg's twelve-tone music, see Michael L. Friedman, 'A Methodology for the Discussion of Contour: Its Application to Schoenberg's Music', *Journal of Music Theory*, 29 (1985), pp. 223–48.

33 For a more extensive discussion of Schoenberg's use of invariant harmonies and their relation to form, see my 'Musical Form and the Development of Schoenberg's Twelve-Tone Method', *Journal of Music Theory*, 29 (1985), pp. 85–143.

34 I am indebted to Wayne Petty for having first noticed how Schoenberg creates artificial invariants in op. 33b.

35 Edward Steuermann, 'Schoenberg: Complete Piano Music', Columbia Masterworks, ML 5216, c. 1945; Maurizio Pollini, 'The Piano Works of Arnold Schoenberg', Hamburg: Deutsche Grammophon, 423 249–2, c. 1988.

36 Schoenberg worked extensively with Steuermann in preparation for the performance of his piano works and enthusiastically endorsed his pianistic abilities. In light of this relationship, we might give due weight to Steuermann's comments published with this recording, which are particularly revealing about this passage from op. 33b:

> The novelty and originality of Schoenberg's piano style is often overlooked.... The pianist is confronted with new problems. It is mainly the extremely scarce use of pedal which often deprives the sound of the romantic vibration for which the piano is known, and the polyphony requires the most exact differentiation by the use of all kinds of touch.

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