CHAPTER 5
Basic Twelve-Tone Operations

TWELVE-TONE SERIES

Until now, we have discussed music largely in terms of *unordered* sets of pitch classes. In what follows, we will concentrate on *ordered* sets, which we will call *series*. A series is a line, not a set, of pitch classes. A pitch-class set retains its identity no matter how its pitch classes are ordered. In a series, however, the pitch classes occur in a particular order; the identity of the series changes if the order changes.

A series can be any length, but by far the most common is a series consisting of all twelve pitch classes. A series of twelve different pitch classes is sometimes called a *set* (a usage we will avoid because of the possibility of confusion with unordered pitch-class sets) or *row*. Music that uses such a series as its basic, referential structure is known as *twelve-tone music*.

A twelve-tone series plays many musical roles in twelve-tone music. In some ways it is like a theme, a recognizable "tune" that recurs in various ways throughout a piece. In some ways it is like a scale, the basic referential collection from which harmonies and melodies are drawn. In some ways it is a repository of motives, a large design within which are embedded numerous smaller designs. But it plays a more fundamental role in twelve-tone music than theme, scale, or motive play in tonal music. In tonal music, the scales and even to some extent the themes and motives are part of the common property of the prevailing musical style. From piece to piece and from composer to composer, a great deal of musical material is shared. Tonal music is relatively communal. In twelve-tone music, however, relatively little is shared from piece to piece or composer to composer; virtually no two pieces use the same series. Twelve-tone music is

thus relatively contextual. The series is the source of structural relations in a twelve-tone piece: from the immediate surface to the deepest structural level, the series shapes the music.

BASIC OPERATIONS

Like unordered pitch-class sets, twelve-tone series can be subjected to various operations like transposition and inversion for the sake of development, contrast, and continuity. There is an important basic difference, however. When a set of fewer than twelve elements is transposed or inverted, the content of the set usually changes. When any member of 4–1 (0123), for example, is transposed up two semitones, two new pitch classes will be introduced. The operation of transposition thus changes the content of the collection. When a twelve-tone series is transposed, however, the content remains the same. If you transpose the twelve pitch classes, you just get the same twelve pitch classes, but in a different order. The same is true of inversion. In the twelve-tone system, the basic operations—transposition and inversion—affect order, not content.

The series is traditionally used in four different orderings: prime, retrograde, inversion, and retrograde-inversion. Some statement of the series, usually the very first one in the piece, is designated the prime ordering and the rest are calculated in relation to it. Schoenberg's String Quartet No. 4, for example, begins as shown in Example 5–1.

Example 5–1 Presenting the series—the initial statement is designated P_0 (Schoenberg, String Quartet No. 4).

The melody in the first violin presents all twelve pitch classes in a clear, forthright way. We will consider this the prime ordering for the piece. Previously, we used a "fixed *do*" integer notation and always assigned 0 to C. In most of our discussions of twelve-tone music, however, we will use a "moveable *do*" integer notation and assign 0 to the first pitch class in the first statement of the prime ordering of the series. In the example above, the first pitch class, D, is called 0, C♯ is 11, A is 7, and so on. The prime ordering of the series beginning on 0 is called P_0.

Figure 5–1 shows P_0 for Schoenberg's String Quartet No. 4 and the interval succession it describes.

ordered pitch-class intervals: 11 8 1 7 10 1 8 8 11 11 5

P_0: 0 11 7 8 3 1 2 10 6 5 4 9

Figure 5–1

Let's see what happens if we transpose P_0 up seven semitones (see Figure 5–2).

ordered pitch-class intervals: 11 8 1 7 10 1 8 8 11 11 5

P_7: 7 6 2 3 10 8 9 5 1 0 11 4

Figure 5–2

The order of the pitch classes changes: the 0 was first, now it is toward the end; the 7 was third, now it is first; and so on. In fact, no pitch class occupies the same order position it did. The content, of course, is the same (both P_0 and P_7 contain all twelve pitch classes) and, more important, so is the interval succession. That particular interval succession is what defines the prime ordering of this series. We can produce that succession beginning on any of the twelve pitch classes. P_0 is the prime ordering beginning with pitch class 0; P_1 is the prime ordering beginning with pitch class 1; and so on. There are twelve different forms of the prime ordering: $P_0, P_1, P_2, \ldots, P_{11}$.

As for the other orderings (retrograde, inversion, and retrograde-inversion), we can think of them either in terms of their effect on the pitch classes or their effect on the intervals. In terms of pitch classes, the retrograde ordering simply reverses the prime ordering. What happens to the interval succession when P_0 is played backwards (an ordering called R_0)? Figure 5–3 demonstrates.

ordered pitch-class intervals: 7 1 1 4 4 11 2 5 11 4 1

R_0: 9 4 5 6 10 2 1 3 8 7 11 0

Figure 5–3

The interval succession is reversed and each interval is replaced by its complement mod 12 (1 becomes 11, 2 becomes 10, etc.). As with the prime ordering, there are twelve different forms of the retrograde ordering: $R_0, R_1, R_2, \ldots, R_{11}$. (Remember that R_0 is the retrograde of P_0, R_1 the retrograde of P_1, and so on. R_0 thus ends rather than begins on 0.)

The inversion of the series involves inverting each pitch class in the series: pitch class 0 inverts to 0, 1 inverts to 11, 2 inverts to 10, 3 inverts to 9, and so on. Figure 5–4 shows the interval succession for I_0, the inverted ordering that begins on pitch class 0.

ordered pitch-class intervals: 1 4 11 5 2 11 4 4 1 1 7

I_0: 0 1 5 4 9 11 10 2 6 7 8 3

Figure 5–4

The interval succession here is the same as that of the prime ordering, but each interval is replaced by its complement mod 12. The intervals are the same as in the retrograde, but in reverse order. As with the prime and retrograde orderings, we can reproduce this interval succession beginning on any of the twelve pitch classes. The twelve resulting series-forms will be called $I_0, I_1, I_2, \ldots, I_{11}$.

The retrograde-inversion of the series is simply the retrograde of the inversion. Figure 5–5 shows the interval succession for RI_0 (I_0 played backwards).

ordered pitch-class intervals: 5 11 11 8 8 1 10 7 1 8 11

RI_0: 3 8 7 6 2 10 11 9 4 5 1 0

Figure 5–5

The interval succession here is similar to that of the other three transformations. It is particularly interesting to compare it to that of the prime ordering. In terms of pitch classes, the two orderings seem far apart: each is the upside-down-and-backwards version of the other. In terms of intervals, however, the two are quite similar: they have the same intervals in reverse order. Compared to the retrograde, the retrograde-inversion has the complementary intervals in the same order; compared to the inversion, it has the complementary intervals backwards. As with the other three transformations, the retrograde-inversion can begin on any of the twelve pitch classes. The resulting series-forms are named RI_0 (the retrograde of I_0), RI_1 (the retrograde of I_1), . . . , RI_{11} (the retrograde of I_{11}).

For any series, we thus have a family of 48 series-forms: twelve primes, twelve retrogrades, twelve inversions, and twelve retrograde-inversions. All the members of the family are closely related in terms of both pitch classes and intervals. Figure 5–6 shows the intervals described by the four different orderings of the series from Schoenberg's Quartet No. 4.

	ordered pitch-class intervals										
Prime:	11	8	1	7	10	1	8	8	11	11	5
Retrograde:	7	1	1	4	4	11	2	5	11	4	1
Inversion:	1	4	11	5	2	11	4	4	1	1	7
Retrograde-Inversion:	5	11	11	8	8	1	10	7	1	8	11

Figure 5–6

Notice the predominance of intervals 1, 4, 8, and 11 and the complete exclusion of 3 and 9 in all four orderings (and thus in all 48 series-forms). Because of these shared intervallic features (and many other features to be discussed later), the forms of a series are closely related to one another. Each of them can impart to a piece the same distinctive sound.

In studying a twelve-tone piece, it is convenient to have at hand a list of all 48 forms of the series. We could just write out all 48 either on staff paper or using the pitch-class integers. More simply, we could write out the twelve primes and the twelve inversions (using the musical staff, letter names, or pitch-class integers) and simply find the retrogrades and retrograde-inversions by reading backwards. The simplest way of all, however, is to construct what is known as a "12 × 12 matrix." To construct such a matrix, begin by writing P_0 horizontally across the top and I_0 vertically down the left side (see Figure 5–7).

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

Figure 5–7

Then write in the remaining prime orderings in the rows from left to right, beginning on whatever pitch class is in the first column. The second row will contain P_1, the third row will contain P_5, and so on (see Figure 5–8).

I ↓ (column 6)

	0	11	7	8	3	1	2	10	6	5	4	9	
	1	0	8	9	4	2	3	11	7	6	5	10	
	5	4	0	1	8	6	7	3	11	10	9	2	
	4	3	11	0	7	5	6	2	10	9	8	1	
	9	8	4	5	0	10	11	7	3	2	1	6	
	11	10	6	7	2	0	1	9	5	4	3	8	
P →	10	9	5	6	1	11	0	8	4	3	2	7	← R
	2	1	9	10	5	3	4	0	8	7	6	11	
	6	5	1	2	9	7	8	4	0	11	10	3	
	7	6	2	3	10	8	9	5	1	0	11	4	
	8	7	3	4	11	9	10	6	2	1	0	5	
	3	2	10	11	6	4	5	1	9	8	7	0	

↑ RI (column 6)

Figure 5–8

The same matrix could also be written using letter names instead of pitch-class integers. The rows of the matrix, reading from left to right, contain all of the prime forms and, reading from right to left, the retrograde forms. The columns of the matrix reading from top to bottom contain all of the inverted forms and, from bottom to top, the retrograde-inversion forms.

The matrix thus contains an entire small, coherent family of 48 closely related series-forms: twelve primes, twelve retrogrades, twelve inversions, and twelve retrograde-inversions. All of the essential pitch material in a twelve-tone piece is normally drawn from among those 48 forms. In fact, most twelve-tone pieces use far fewer than 48 different forms. The material thus is narrowly circumscribed yet permits many different kinds of development. A composer builds into the original series (and thus into the entire family of 48 forms) certain kinds of structures and relationships. A composition based on that series can express those structures and relationships in many different ways.

One good way of getting oriented in a twelve-tone work is by identifying the series-forms. This is informally known as "twelve-counting," and it can provide a kind of low-level map of a composition. The first step in twelve-counting is to identify the series. It is usually presented in some explicit way right at the beginning of the piece, but sometimes a bit of detective work is needed. For an example, let's turn back to Webern's song "Wie bin ich froh!" discussed in Analysis 1. The melody for the passage we discussed, measures 1–5, presents the twelve-tone series for the piece, and then repeats its first four notes (see Example 5–2).

Example 5–2 The melody presents the P_0 form of a twelve-tone series (Webern, "Wie bin ich froh!").

We will designate that form of the series as P_0 because it is so prominent and easy to follow. Notice the usual twelve-counting procedure of identifying the

order-position each pitch occupies in the series-form (G is first, E is second, and so on).

Now the problem is to identify the series-forms used in the accompaniment. We could construct a 12 × 12 matrix. Then we could take the first few notes in the accompaniment (F♯, F, D) and see which of the 48 forms begins like that. That would work perfectly well, but instead let's try a different, interval-oriented approach. Look at the succession of ordered pitch-class intervals described by P_0 (see Figure 5–9).

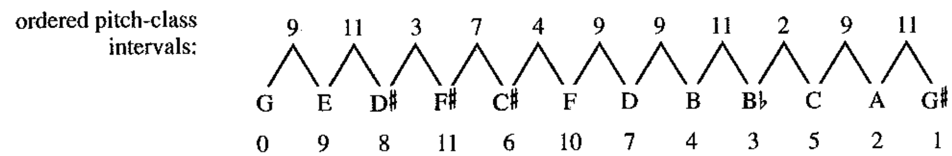


Figure 5–9

Now look at the ordered pitch-class intervals described by the first five notes of the accompaniment (see Figure 5–10).

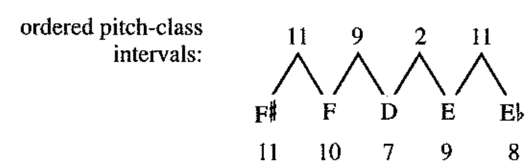


Figure 5–10

It starts out with the same intervals that P_0 ended with, but in reverse order. That means we are dealing with an RI-form. At what transposition level? Just add the first note in the accompaniment (F♯) to the last note in P_0 (G♯), the second note in the accompaniment (F) to the second-to-last note in P_0 (A), and so on. In this way, we calculate the index number that maps these series-forms onto one another. Since G, the first note of P_0, is 0, the sum in each case is 0. So the accompaniment begins with RI_0. If we had designated the accompaniment as P_0, then the melody would have been RI_0.

This passage uses only P_0 and RI_0, and the entire song uses only P_0, I_0, and the retrogrades of these (see Example 5–3).

Example 5–3 A "twelve-count" of melody and accompaniment.

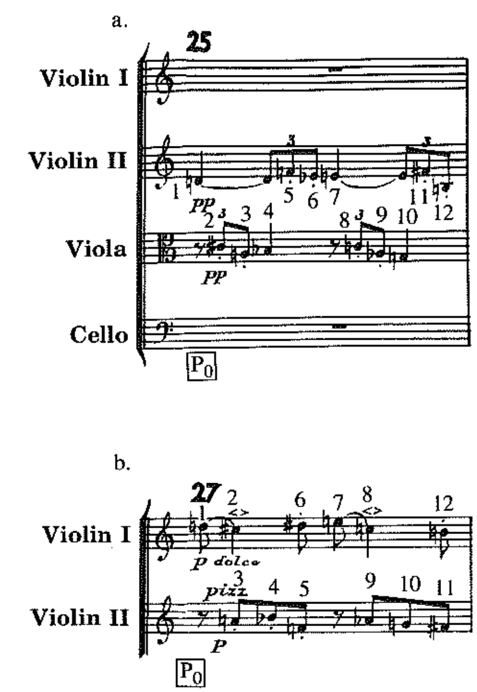
Notice that occasionally a single note can be simultaneously the last note of one series-form and the first note of the next. The G in the accompaniment in measure 2, for example, is both the last note in RI_0 and the first note in P_0. This kind of overlap is typical of Webern. A twelve-count like this doesn't do much to help us hear the song better—the intervallic relationships discussed in Analysis One are probably more useful in that way—but it does give a rough structural outline of the piece. It also gives a useful and clarifying context for those intervallic relationships.

There is nothing mechanical about either the construction of the series or its musical development in a composition. A composer of tonal music is given certain materials to work with, including, most obviously, diatonic scales and

major and minor triads. The composer of twelve-tone music must construct his or her own basic materials, embedding them within the series. When it comes time to use those basic materials in a piece of music, a twelve-tone composer, like a tonal composer, does so in the way that seems musically and expressively most congenial. A good composer doesn't just lay series-forms end-to-end any more than Mozart simply strings scales together.

Once a series has been constructed, a process we will describe more later, just think how many compositional decisions are still required to turn it into music. Should the notes be sounded one at a time or should some of them be heard simultaneously? In what registers should they occur? Played by what instruments? With what durations? What articulations? It is like being given a C-major scale and told to compose some music. There are certain restrictions, but a great deal of freedom as well.

Example 5–1 showed the beginning of Schoenberg's String Quartet No. 4, where P_0 is presented as a singing melody in the first violin. Example 5–4 shows two other statements of P_0, both from the opening section of the piece.



Example 5–4 Two additional statements of P_0 (Schoenberg, String Quartet No. 4).

The musical idea is recognizable in each case, but wonderfully varied. Schoenberg takes a basic shape, then endlessly reshapes it. The construction of the series, the choice of series-forms, and, most important, the presentation of the series are musical decisions based on hearable musical relationships.

SUBSET STRUCTURE

A series is built up from its smaller parts, its subsets. The sound of the series, and thus the sound of a piece based on the series, is shaped by the structure of its subsets. We have already mentioned the dyads (intervals) formed by the adjacent notes. It is possible to construct series with very different intervallic characteristics. Webern, for example, prefers series that use only a few different intervals and that make particularly heavy use of interval class 1. Berg, in contrast, has a preference for series that use the triadic intervals, interval classes 3, 4, and 5. In a very rough way, those contrasting preferences account for the difference in the sound of Webern's and Berg's twelve-tone music.

In addition to the dyads, we can consider subsets of any size, but those of three, four, or six elements are usually the most important. Composers tend to embed within the series those smaller sets they are interested in using. To put it another way, they usually build up their series by combining a number of smaller sets. As listeners, most of us find it hard to grasp a series as a whole and pretty much impossible to recognize when a series is being turned upside down and backwards, for example. Luckily for us, most twelve-tone music does not require that we be able to hear things like that. Instead, all we have to listen for are the smaller collections, the intervals and subsets embedded within the series.

Remember that every form of a series will have the same subset structure. If, for example, the first three notes of P_0 create set class 3–9 (027), then so will the first three notes of all the P-forms and I-forms, and the last three notes of all the R-forms and RI-forms. That is because set-class membership is not affected by transposition, inversion, or reordering. We will look at the subset structure of two different series, and then suggest briefly some of the ways that structure is reflected musically.

Consider again the series from Schoenberg's String Quartet No. 4. It is shown in Figure 5–11 with various subsets identified.

discrete trichords: D C♯ A | B♭ F E♭ | E C A♭ | G F♯ B
3–4 (015) | 3–9 (027) | 3–12 (048) | 3–4 (015)

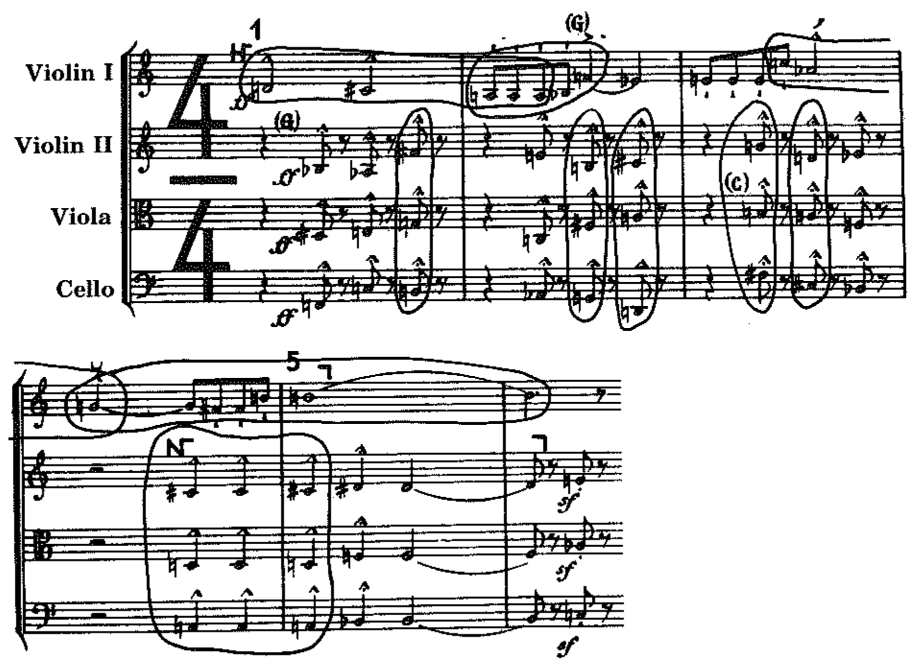
some other trichords: D C♯ [A B♭ F] E♭ E [C A♭ G] F♯ B
3–4 (015) | 3–4 (015)

discrete tetrachords: D C♯ A B♭ | F E♭ E C | A♭ G F♯ B
4–7 (0145) | 4–4 (0125) | 4–4 (0125)

some other tetrachords: D [C♯ A B♭ F] [E♭ E C A♭] G F♯ B (also [E C A♭ G])
4–19 (0148) | 4–19 (0148) 4–19 (0148)

Figure 5–11

As you can see, the organization of the series features certain sets. These featured sets become important musical motives. The trichord 3–4 (015), for example, occurs many times within the series. In the beginning of the Quartet, the music divides the series into its four *discrete* trichords. (The discrete subsets are the ones that divide the series into equal portions. There are four discrete trichords, three discrete tetrachords, and two discrete hexachords in every series.) Each trichord in the melody is accompanied by the remaining three trichords in the other instruments. While the first violin plays the first trichord (D–C♯–A), the remaining instruments play the second (B♭–F–E♭), third (E–C–A♭), and fourth (G–F♯–B). When the first violin plays the second trichord, the other instruments play the first, third, and fourth, and so on. Each trichord thus occurs four times in the passage, once in the melody and three times in the accompaniment. Since two of the discrete trichords are members of set class 3–4 (015), and since that set class also occurs in two other places in the series, the passage can be heard, in part, as the varied presentations of that musical idea (see Example 5–5).



Example 5–5 The trichord 3–4 (015), a subset of the series.

As for the tetrachords, let's focus our attention on a single set class, 4–19 (0148), that occurs three times in the series (and therefore three times in the first-violin melody in measures 1–6). We have seen that this passage involves a melody accompanied by three-note chords. But how does Schoenberg choose which melody note will sound with each chord? In measure 1, for example, why does the melodic C♯ come with the second chord instead of, say, the third chord? In measure 2, the melodic A might more logically have been heard back in measure 1 with the third chord. Why does it occur where it does?

In both cases, the answer seems to be that, with this particular vertical alignment, Schoenberg is able to reproduce set classes from the series (see Example 5–6).

Example 5–6 The vertical alignment of tones that are not contiguous in the series produces a set class, 4–19 (0148), that does occur as a linear subset of the series.

The melodic C♯ and the second chord in measure 1 are *not* contiguous within P_0. When they sound together, however, they create a form of 4–19 (0148), a set class that *does* occur as a linear segment of the series. The same thing happens in measures 2 and 6. These vertical alignments are not determined by the series—they result from independent compositional choices. In this piece, Schoenberg has taken care that both the linear dimension and the relatively free vertical dimension express the same musical ideas, ideas that he has embedded in his series. In this way, the series achieves an even deeper influence on the music.

A very different series, from Webern's Concerto for Nine Instruments, Op. 24, is shown in Figure 5–12, with its discrete trichords indicated.

3–3 (014)	3–3 (014)	3–3 (014)	3–3 (014)
G B B♭	D♯ D F♯	E F C♯	C A♭ A

Figure 5–12

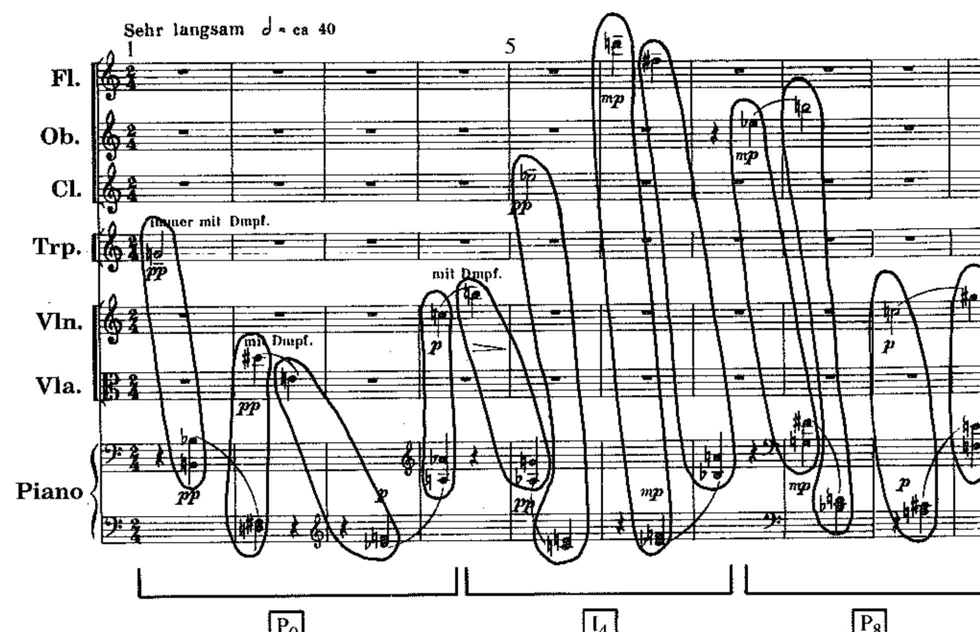
As you can see, all four of the discrete trichords are members of the same set class. A series like this is said to be *derived* from 3–3 (014); that set class is the *generator* of the series. Any trichord (except 3–10 (036)) can act as a generator. It is also possible to derive a series from a tetrachord. In that case, all three discrete tetrachords must be members of the same set class. Any tetrachord that excludes interval class 4 can act as generator. A derived series makes possible an extraordinary motivic unity. As an added bonus, Webern has ordered each trichord so that if the first trichord is considered to be in a prime ordering (P_0), the second is the retrograde-inversion (RI_{11}), the third the retrograde (R_6), and the fourth the inversion (I_5). (See Figure 5–13.)

G B B♭	D♯ D F♯	E F C♯	C A♭ A
P_0	RI_{11}	R_6	I_5

Figure 5–13

The operations of the system are thus reflected even at this micro-level. This permits a particularly intense kind of motivic development. Let's see how Webern writes music using this series.

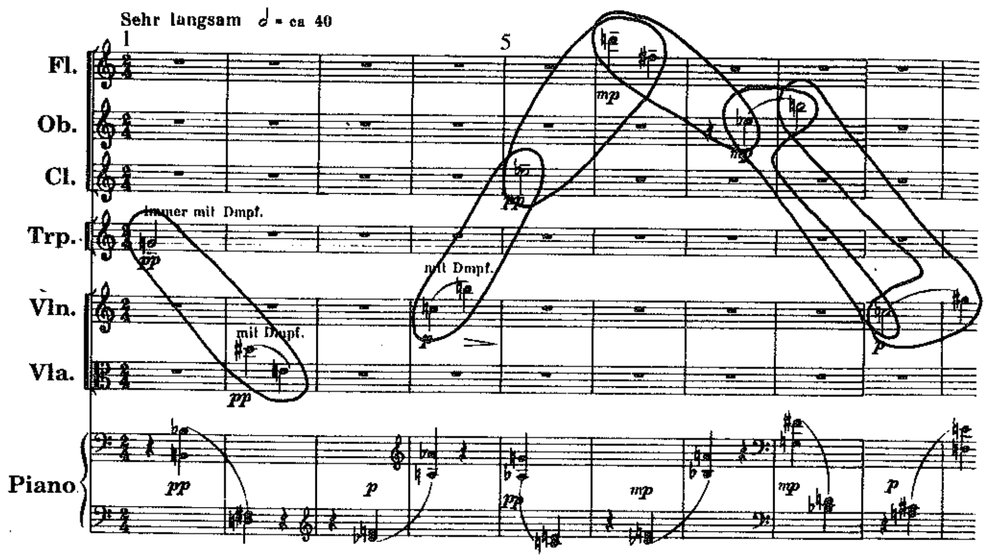
Example 5–7 shows the first nine measures of the second movement of Webern's Concerto, with the series-forms and the discrete trichords marked. All of them, of course, are members of 3–3 (014).



Example 5–7 All four discrete trichords of the series are members of the same set class, 3–3 (014) (Webern, Concerto for Nine Instruments, Op. 24).

As always, we will fare better as listeners if we focus not on the series as a whole but on the smaller units—in this case, on the highly concentrated development of set class 3–3 (014). Every time a form of the series is stated, we are assured of hearing four statements of that set class.

The influence of the series (and its prominent 3–3s) goes far beyond those simple, direct statements. Consider the organization of the melodic line (that is, all the instruments except the accompanying piano). (See Example 5–8.)

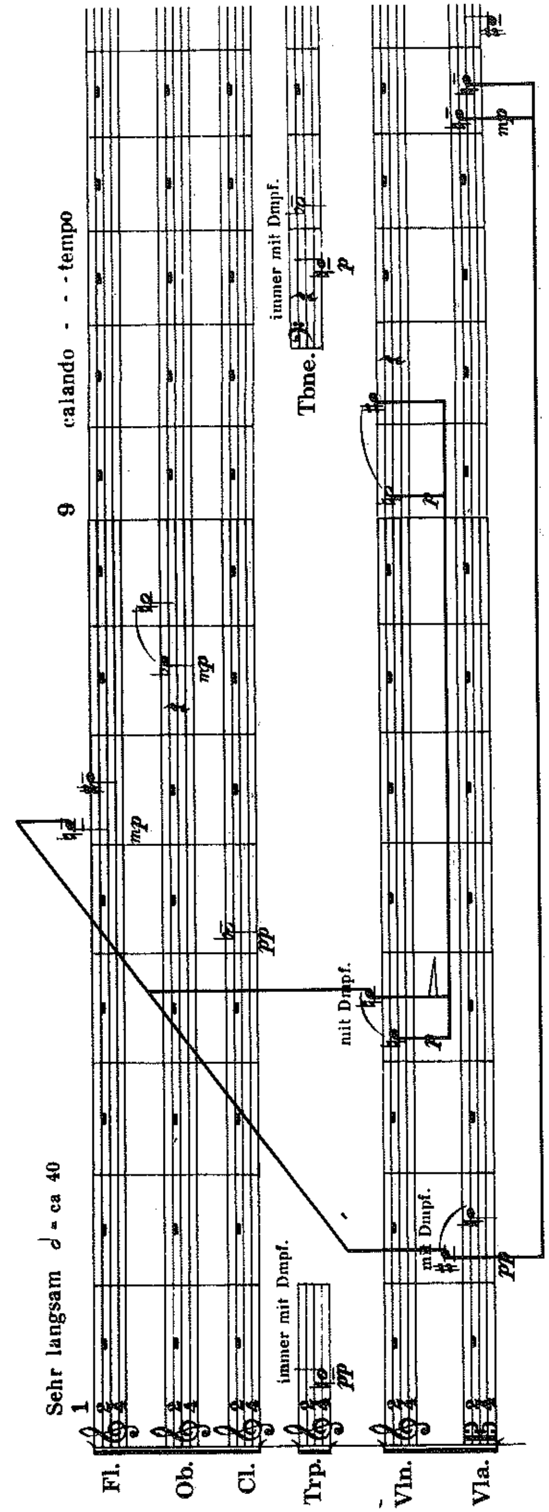


Example 5–8 The set class that generates the series, 3–3 (014), permeates the melodic line.

The notes in this line are by no means all contiguous within the series. The first circled trichord, for example, contains the first, fourth, and seventh notes of P_0. Yet this and all the other circled trichords in the melody are members of 3–3 (014), a set class that does occur directly in the series.

The influence of the series extends even to the instrumentation, registers, and articulations of the passage (see Example 5–9). The viola, for example, plays two notes in measure 2 (the fourth and seventh notes of P_0) and then is silent until measure 13, when it plays two more notes (the first and fourth notes of P_9). These four notes together (the E is repeated), associated by instrumentation, create a 3–3 (014), the very set class from which the series is derived. The same sort of thing happens in the violin part.

The registers and articulations are similarly influenced by the series. In measures 2, 4, and 6, a melodic instrument plays a pair of notes. The highest notes of each pair, taken together, again create 3–3 (014). This is easy and rewarding to hear and shows the profound role of the series in shaping all aspects of the musical structure.



Example 5–9 The trichord that generates the series, 3–3 (014), also influences the instrumentation, register, and articulation.

In analyzing twelve-tone pieces, it is often best to begin by identifying the occurrences of the series. But that is only the barest beginning. The series is not a static object to be mechanically repeated again and again, but a rich network of musical relationships to be expressed and developed in a multitude of ways.

BIBLIOGRAPHY

Virtually all modern work in twelve-tone theory stems from the writing and teaching of Milton Babbitt. He has written a series of seminal articles, including: "Some Aspects of Twelve-Tone Composition," *The Score and I.M.A. Magazine* 12 (1955), pp. 53–61: "Twelve-Tone Invariants as Compositional Determinants," *Musical Quarterly* 46 (1960), pp. 246–59; and "Set Structure as a Compositional Determinant," *Journal of Music Theory* 5/2 (1961), pp. 72–94. Some of this material is presented more informally in *Milton Babbitt: Words About Music*, ed. Stephen Dembski and Joseph N. Straus (Madison: University of Wisconsin Press, 1987).

Pedagogical discussion of basic twelve-tone concepts can be found in Robert Gauldin, "A Pedagogical Introduction to Set Theory," *Theory and Practice* (1978), pp. 3–14; and Charles Wuorinen, *Simple Composition* (New York: Longman, 1979). See also Schoenberg's own presentation of the topic: "Composition with Twelve Tones," in *Style and Idea* (Berkeley and Los Angeles: University of California Press, 1975).

Robert Morris's "Set-type Saturation among Twelve-tone Rows," *Perspectives of New Music* 22/1–2 (1983–84), pp. 187–217, is a study of the subset structure of twelve-tone series.

EXERCISES

I. Basic operations: A series is traditionally used in four different orderings: prime (P), inversion (I), retrograde (R), and retrograde-inversion (RI). Each of these four orderings may begin on any of the twelve pitch classes. Use the following twelve-tone series in answering the succeeding questions.

1. Perform the following operations on each series. (Give your answer both in integers and in staff notation).
- **a.** P_7
- **b.** R_{10}
- **c.** RI_6
- **d.** I_5

2. Each of the following series is a transformation of one of the four given above. Identify the series and the transformation.
- **a.** 7, 6, 2, 11, 9, 4, 10, 3, 5, 8, 0, 1
- **b.** 3, 4, 8, 7, 0, 2, 1, 5, 9, 10, 11, 6
- **c.** 4, 6, 0, 1, 5, 7, 2, 11, 9, 8, 3, 10
- **d.** 8, 7, 11, 0, 4, 3, 5, 1, 2, 9, 10, 6
- **e.** 9, 10, 6, 5, 1, 2, 0, 4, 3, 8, 7, 11
- **f.** 10, 5, 6, 7, 11, 3, 2, 4, 9, 8, 0, 1

3. For each of the notated series, construct a 12 × 12 matrix. Using the matrix, check your answers to the previous questions.

4. Indicate whether the following statements are true or false. (If false, make the necessary correction.)
- **a.** The prime and retrograde-inversion have the same intervals in reverse order.
- **b.** The inversion and retrograde-inversion have complementary intervals in reverse order.
- **c.** The retrograde and inversion have complementary intervals in the same order.

II. Subset structure: The constituent groupings within a series are its subsets.

1. For each of the notated series, identify the set classes to which the following belong:
- **a.** the discrete trichords; the remaining trichords
- **b.** the discrete tetrachords; the remaining tetrachords
- **c.** the discrete hexachords; the remaining hexachords

2. Construct at least one twelve-tone series for each of the following characteristics:
- **a.** Its discrete trichords are members of the same set class. (Use a trichord other than 3–1 (012).)
- **b.** Its discrete tetrachords are members of the same set class. (Use a tetrachord other than 4–1 (0123).)
- **c.** Its hexachords are related to each other by inversion, and two of its discrete tetrachords are members of the same set class.
- **d.** As many segmental subsets as possible are members of set class 3–3 (014).
- **e.** It uses each of the eleven ordered pitch-class intervals once.
- **f.** Every other interval is a member of interval class 1.
- **g.** Its first and fourth trichords are members of the same set class, as are its second and third trichords.
- **h.** It has the same ordered pitch-class intervals as its retrograde.

Analysis 5

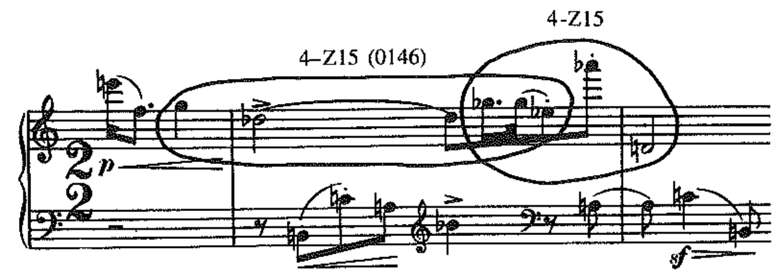
Schoenberg, Suite for Piano, Op. 25, Gavotte
Stravinsky, *In Memoriam Dylan Thomas*

The Gavotte from Schoenberg's Suite for Piano, Op. 25, (like the entire Suite) is based on a twelve-tone series. But rather than beginning with the series, let's plunge right into an examination of the first phrase of music, shown in Example A5–1, to discover what sorts of musical ideas Schoenberg is working with.

Example A5–1 First phrase of the Gavotte from Schoenberg's Suite for Piano, Op. 25.

Play the phrase and think about what is gavottelike about it. A gavotte is a Baroque dance in duple meter that usually begins and ends in the middle of the bar and places some stress on the second beat of the measure. It is usually quite simple rhythmically. Schoenberg's gavotte exhibits each of these aspects. Its simple two-voice texture also recalls familiar Baroque models. At the same time, of course, the melodies, motives, and harmonies have little in common with those of a Baroque work. Schoenberg has been severely criticized, by the composer Pierre Boulez among others, for mixing old forms with a new musical language. In this critical view, it would have been more consistent and more convincing if Schoenberg had devised new forms that grew organically from his new language. Schoenberg's defenders have responded that, far from a sign of weakness, his use of old forms shows the power of his new musical language both to create musical coherence and, at the same time, to remake the old forms. He creates beautiful new works that subtly, and ironically, imitate old ones.

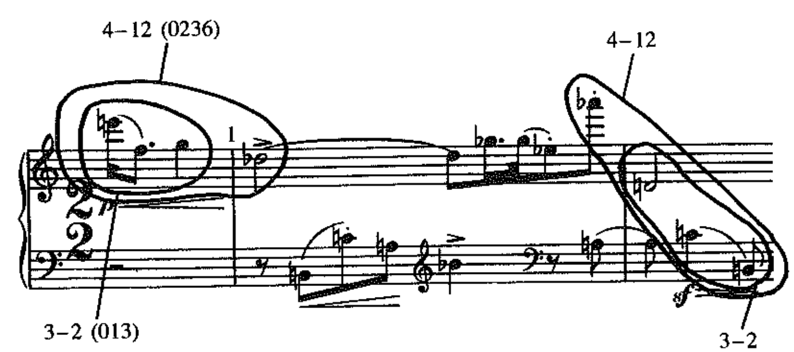
Now play the phrase again and listen particularly to the intervallic and motivic structure of the melodic line in the right hand. That melody is divided into two groups of four notes. Those two groups balance one another in duration and shape, and each ends on a tritone: G–D♭ for the first group and A♭–D for the second. The tritones are rhythmically similar—the second note of each tritone is a half-note on the downbeat of a measure. The second tritone, with its wide intervallic span, sounds like an expansion of the first one. Between the tritones, connecting them, is the descending 3 from G♭ to E♭. Those two pitch classes form, with each of the tritones, a member of set class 4-Z15 (0146). (See Example A5–2.)



Example A5–2 Two tritones linked by a 3 to create two overlapping forms of 4–Z15 (0146).

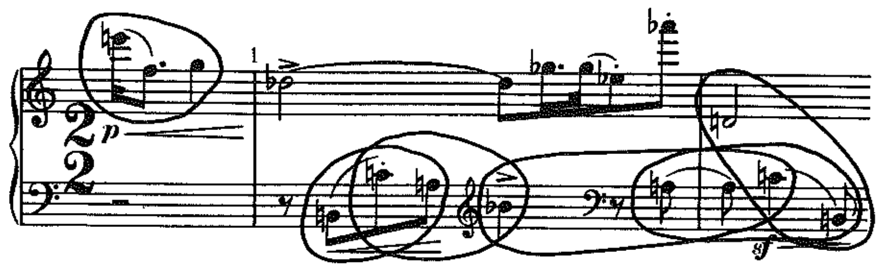
The dyad G♭–E♭ thus draws the tritones together and balances them. Play the melodic line and listen for this.

The first tritone, G–D♭, is preceded by a member of interval class 1, E–F. Similarly, the second tritone, A♭–D, is followed, in the left hand, by another 1, C–B. In both cases, the combination of interval class 1 with the tritone creates a form of set class 4–12 (0236). As with the statements of 4-Z15 (0146), these two statements of 4–12 enhance the sense of melodic balance in the phrase. Within each of these forms of 4–12 are prominent statements of 3–2 (013). (See Example A5–3.)



Example A5–3 Two tritones preceded and followed by a semitone to create two balancing forms of 4–12 (0236).

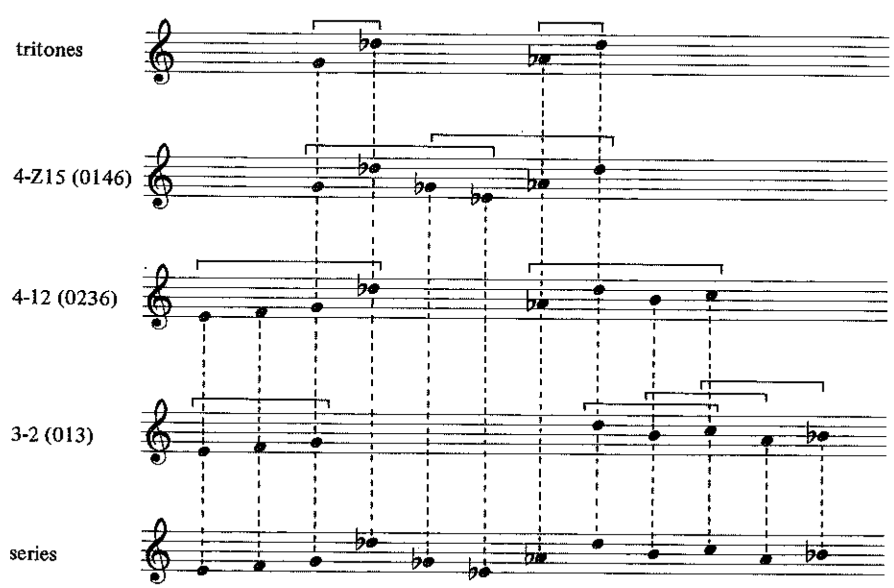
The first three notes in the phrase, E–F–G, and the last three notes in the phrase, D–C–B, both form members of 3–2 (013). In addition, other forms of the same set class are embedded in the left-hand part. That part begins with B–C–A, overlapped with C–A–B♭. When the B♭ is reached, the pitches are stated in reverse order: B♭–A–C is overlapped with A–C–B. All of these are members of 3–2. (See Example A5–4.)



Example A5–4 Six forms of set class 3–2 (013).

Notice also that the last four notes in the left hand, B♭–A–C–B, spell out the name of Bach (in German nomenclature, B = B♭ and H = B). This motive has been used by many composers as an homage to Bach. (We will see another example of it in Webern's String Quartet, Op. 28, in the following chapter.) It seems particularly appropriate here where Schoenberg is so clearly evoking the musical style of the eighteenth century. The retrograde-symmetry in the left hand—it is the same from right to left as it is from left to right—and the melodic balance in both parts help to unify the phrase. Play the phrase again and listen for the sense of musical balance.

The musical ideas we have been discussing are embedded in the twelve-tone series for this piece. As Example A5–5 shows, the series is built up from the interaction of its subsets.



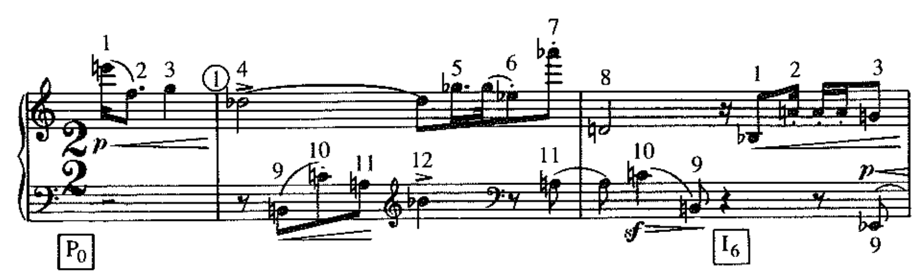
Example A5–5 The series built up from the interaction of the musical ideas it contains.

Far from being an arbitrary or mechanical listing of notes, a twelve-tone series is the embodiment of interrelated musical ideas. A piece of music based on a series will be concerned with the musical ideas contained in the series.

In principle, 48 forms of the series are available and could be summarized in a 12 × 12 matrix. In practice, however, most twelve-tone pieces use far fewer than 48 forms, and Schoenberg's Gavotte uses only four: P_0, P_6, I_0, and I_6. These are written out in notes and integers (E = 0) in Example A5–6.

Example A5–6 Four forms of the series.

As we've already noted, one way of getting oriented in a twelve-tone piece is to do a "twelve-count," identifying the forms of the series being used and the order position in the series of each pitch class. A twelve-count for measures 1–8 of the Gavotte is provided in Example A5–7. Occasionally, a single pitch will be simultaneously the last note of one series-form and the first note of the next.



(continued)

Example A5–7 A "twelve-count."

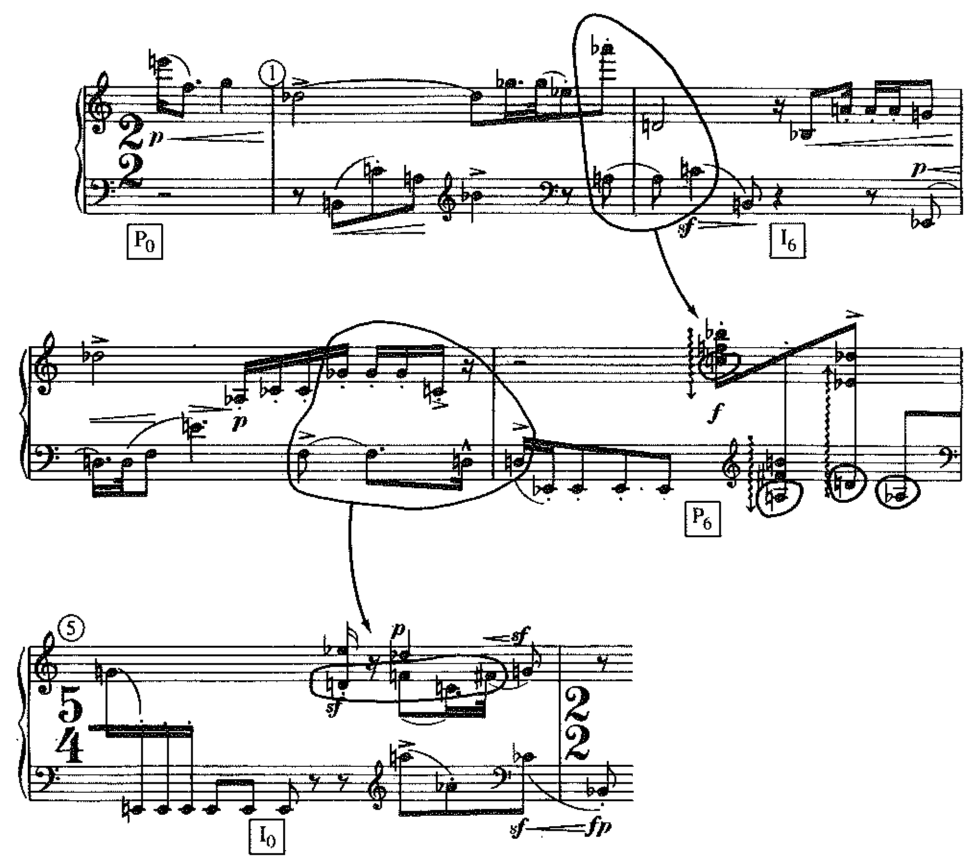
Example A5–7 (*continued*)

But while such a twelve-count can help us get oriented, it hardly begins to answer the kinds of musical questions that normally concern us—questions of harmonic and motivic organization, questions of rhythm and phrase structure, questions of contour and shape. We have already tried to approach these questions in the discussion of measures 1–2. Now let's see how the musical ideas presented there are developed in the subsequent music.

The second phrase, measures 2–4, balances the first in a kind of antecedent-consequent formation. Just as the first phrase is balanced within itself, the second phrase balances the first to form a larger musical unit. Play the second phrase, and notice, as in the first, the two tritones joined by an interval 3, preceded and followed by an interval class 1, accompanied by a retrograde-symmetrical line in the left hand consisting of overlapping forms of 3–2 (013). Of the two tritones in the second phrase, one of them, G–D♭, is the same as in the first phrase. In fact, all four of the series-forms that Schoenberg uses—P_0, I_0, P_6, and I_6—have that tritone as their third and fourth notes. Figure out why this is so. One of the

reasons that Schoenberg uses the series-forms he does is precisely to feature this particular interval. As you listen to the rest of the piece, you will certainly notice how prominent the interval G–D♭ is throughout.

So far, we have been concerned mainly with the melodic progress of each line, but the lines combine in interesting and significant ways. Consider, for example, what happens at the barline of measure 2, when the melody in the first phrase leaps from A♭ to D, and at the same time the left hand states A and C. These four notes together make up yet another form of 4-Z15 (0146). This form of 4-Z15, however, unlike the others in the first phrase, is not a linear segment of P_0. Rather, it consists of the seventh, eighth, tenth, and eleventh notes of P_0. This form of 4-Z15 does, however, occur as a linear segment of P_6, where it comprises the fifth, sixth, seventh, and eighth notes. The same sort of thing happens in the second phrase. There, the melodic G♭–C combines with F–D in the bass to create a form of 4-Z15 that occurs later as a linear segment of I_0 (see Example A5–8).



Example A5–8 Nonlinear subsets of P_0 and I_6 direct the motion toward P_6 and I_0, where the same collections occur as linear segments.

This example demonstrates two important principles of Schoenberg's twelve-tone music, and of twelve-tone music generally. The first principle is that the vertical combinations of notes, even when they don't follow the strict linear order of the series, still tend to express musical ideas that are found directly in the series. In the Gavotte, 4-Z15 (0146) is a linear subset of the series (it occurs twice). The vertical form in measures 1–2 reflects those linear forms. Tones that are not adjacent in the series are combined to create sets equivalent to those that do occur as contiguous segments of the series. Second, the sets formed by tones that are not adjacent in the series frequently come back later as contiguous segments of other series-forms; that is, they are secondary at one point in a piece, then they become primary later on. In this way, Schoenberg is able to direct the music from place to place. The vertical form of 4-Z15 in the first phrase gets a full linear statement later when the music moves to P_6. In that way, the music is directed from P_0 to P_6 (and, in similar fashion, from I_6 to I_0).

The first section of the piece comes to an end with a big cadence on the downbeat of measure 8. Let's consider some of the musical factors that make it sound cadential. Partly, it's simply a matter of tempo; the music slows down right at that point and then resumes its former tempo. It's also partly a matter of texture and contour; after a passage in which two or three lines move with great independence, all the parts come together here in a homophonic descent culminating in a single low note. There are also some pitch-related factors, as there must be to make a truly convincing cadence. For one thing, the music at this point returns to P_0 for the first time since the beginning of the piece. The melody, E–F–G–D♭, recalls the first four notes of the piece and thus seems to return us to our starting point.

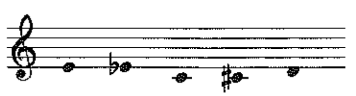
There is more. In this piece, phrases frequently begin and end a tritone apart. If you look back at the structure of the series, you will notice that its first and last notes are a tritone apart. (This is true for all forms of the series.) Since the phrases of the piece frequently coincide with a statement of the series, this phrase-spanning tritone is often in evidence. Look, for example, at the third phrase of the piece, beginning in measure 4 with a high B♭ and ending in measure 5 with the low, repeated Es. The same sort of thing happens over the course of the entire first section of the piece. The first note of the piece is E, in a high register. The section ends on the downbeat of measure 8 with the low, cadential B♭. That very large-scale statement of E–B♭ reflects many briefer statements of that tritone and other tritones. The same musical idea we started with in discussing the melody of the first phrase is thus used over a larger span to link the beginning and end of an entire section of music.

During much of the twentieth century, Schoenberg and Stravinsky were considered antithetical. Schoenberg's new twelve-tone language and Stravinsky's neoclassical return to traditional textures and sonorities seemed to place them in opposing camps of progressives and conservatives. But more recently the connections and similarities between them have become more and more apparent. We have already gotten a hint, in his Gavotte, of Schoenberg's immersion in traditional music and musical forms. As for Stravinsky, close examination of many of his neoclassical

works reveals an almost Schoenbergian concern with motivic saturation and manipulation.

Any gap between the two composers was bridged further in the early 1950s when Stravinsky underwent what he called his second "crisis" as a composer. His first crisis, back around 1920, marked his abandonment of the "Russian" idiom of his early ballets for the more intensive engagement with eighteenth-century models that defined his second, "neoclassical" period. His second crisis led to his embrace of twelve-tone serialism. For some observers, this change seemed an inexplicable capitulation to an alien force. For others, more sensitive to the musical continuities underlying the stylistic change, it came to seem a logical outgrowth of what had come before.

Stravinsky's transition to twelve-tone composition unfolded gradually and was marked by a number of short, experimental pieces. Some of these use a series of fewer than twelve pitch classes. *In Memoriam Dylan Thomas*, a setting of Thomas's well-known poem "Do Not Go Gentle into That Good Night," uses a series of five notes: E–E♭–C–C♯–D (see Example A5–9).



Example A5–9 The five-note series for Stravinsky's *In Memoriam Dylan Thomas.*

Notice the intense intervallic concentration. All the intervals except one are members of interval class 1. The series as a whole comprises a chromatic pentachord, 5–1 (01234). Its first four notes state set class 4–3 (0134), a longtime favorite of Stravinsky's. (As we saw in Chapter 4, this set class was the basic idea for his *Symphony of Psalms*.) The fifth note of the series then fills in the gap in the middle of the set. This idea of creating a chromatic gap and then filling it, or of filling out a chromatic space, is an important one in this work. With a five-note series, a 12 × 12 matrix is obviously out of the question. Instead, the prime and inverted forms of the series are listed below. (The retrograde and retrograde-inversion forms can simply be read backwards.) Notice that for each prime ordering there is an inverted ordering with the same pitch-class content listed across from it.

P_0	E	E♭	C	C♯	D	I_8	C	C♯	E	E♭	D
P_1	F	E	C♯	D	E♭	I_9	C♯	D	F	E	E♭
P_2	F♯	F	D	E♭	E	I_{10}	D	E♭	F♯	F	E
P_3	G	F♯	E♭	E	F	I_{11}	E♭	E	G	F♯	F
P_4	A♭	G	E	F	F♯	I_0	E	F	A♭	G	F♯
P_5	A	A♭	F	F♯	G	I_1	F	F♯	A	A♭	G
P_6	B♭	A	F♯	G	A♭	I_2	F♯	G	B♭	A	A♭
P_7	B	B♭	G	A♭	A	I_3	G	A♭	B	B♭	A
P_8	C	B	A♭	A	B♭	I_4	A♭	A	C	B	B♭
P_9	C♯	C	A	B♭	B	I_5	A	B♭	C♯	C	B
P_{10}	D	C♯	B♭	B	C	I_6	B♭	B	D	C♯	C
P_{11}	E♭	D	B	C	C♯	I_7	B	C	E♭	D	C♯

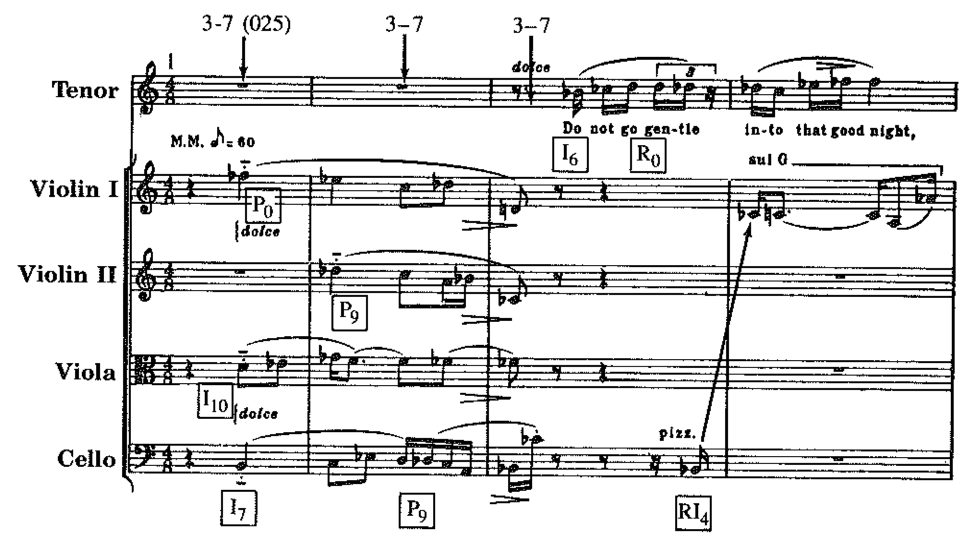
In Stravinsky's setting of Thomas's poem, the singer (a tenor) is accompanied by a string quartet. The setting has a purely instrumental prelude and postlude, scored for string quartet and trombone quartet, which Stravinsky calls "Dirge-Canons." ("Dirge" refers to the emotional quality of the music, and "canons" to the contrapuntal relationships among the parts.) Example A5–10 contains the first phrase of the instrumental prelude.

Example A5–10 First phrase with series-forms marked.

Stravinsky himself identified the orderings of the series using his own personal vocabulary: "Theme" = prime, "Riversion" = retrograde, "Inv." = inversion, and "R. Inv." = retrograde inversion. The modern labels of the series-forms, including their transposition levels, are also given on the example. Sing each of the parts. You will immediately hear their mournful chromatic winding. Now listen for the contrapuntal relationship among the parts. Play just the parts for Tenor Trombone 2 and Bass Trombone 2, and notice that they have a canon at the octave. Now add Tenor Trombone 1 and hear how it imitates the other two a tritone higher. The contrapuntal relationship of Bass Trombone 1 is harder to hear, since it begins with the retrograde ordering of the series. Still, because of the intervallic concentration of the series, it sounds imitative and thickens the contrapuntal web. It also participates in filling out the chromatic space that defines the passage. Each voice fills in all the pitch classes within some span. The four voices together fill in the entire chromatic space from the low C in Bass Trombone 2 up to the high B♭ in Tenor Trombone 1 (with a single missing note). Play all four parts and listen for both the contrapuntal imitations and the filling in of the chromatic space.

Now play it again and listen to the vertical sonorities. Unlike Schoenberg's practice, they do not seem to duplicate set classes formed by subsets of the series. Instead, they are not entirely consistent. (Stravinsky did not solve to his own satisfaction the problem of creating meaningful simultaneities until several years later.) The sonorities used most often are 3–7 (025) and 3–11 (037), the major or minor triad. These diatonic references are by-products of the serial voice leading. The most striking simultaneity is the one that ends the passage. It is an F♭-major (or E-major) triad. Its emergence from the chromatic haze is arresting and dramatic. It is related to the frequent melodic emphasis on pitch class E in this work. Stravinsky here generally prefers series-forms that either begin or end on E; in this way, he creates a sense of centric focus within a serial texture.

The same sorts of musical concerns inform the song itself, the first two phrases of which are shown in Example A5–11.



Example A5–11 First two phrases of the song, with series-forms marked.

The series continues to be developed, now with frequent octave expansions of its invervals. The series-forms used are just those from the first phrase of the prelude: P_0, P_9, I_{10}, and I_7. The texture is not overtly imitative, but the parts are still quite independent rhythmically. The simultaneities are formed more consistently than in the prelude. In the first instrumental phrase, the first and last sonorities are members of set class 3–7 (025). These come about because the first violin moves from E to D while the viola moves from D to E. At each end of this voice exchange, the D–E dyad is accompanied by a B in the other instruments. The same set class is formed in the middle of the passage.

When the voice comes in, it overlaps two series forms, I_6 and R_0. As a result, it fills in the chromatic span of a tritone and reaches up to an arrival point on E, reinforcing that pitch class as a point of centric focus. The motivic ideas in the voice part, particularly the dyads B♭–B and E♭–E, are echoed in the instrumental introduction and in the accompaniment (see Example A5–12).

Example A5–12 Motivic interplay between voice and accompaniment.

The first melodic dyad in the instrumental introduction, E-E♭, (first violin, measure 1) becomes the last melodic dyad in the voice. The last melodic dyad in the instrumental introduction, B♭–B, (cello, measure 3) becomes the first melodic dyad in the voice. That same dyad is also stated at the beginning of the accompaniment in measures 3–4. This kind of interweaving of the vocal line with the instrumental accompaniment continues throughout the song.

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There have been several published studies of Stravinsky's *In Memoriam Dylan Thomas*. See W. R. Clemmons, "The Coordination of Motivic and Harmonic Elements in the 'Dirge-Canons' of Stravinsky's *In Memoriam Dylan Thomas*," *In Theory Only* 3/1 (1977), pp. 8–21; Hans Keller, "*In Memoriam Dylan Thomas*: Stravinsky's Schoenbergian Technique," *Tempo* 35 (1955), pp. 13–20; and David Ward-Steinman, "Serial Technique in the Recent Music of Igor Stravinsky" (Ph.D. diss., University of Illinois, 1961).

CHAPTER 6
More Twelve-Tone Topics

INVARIANTS

When we listen to twelve-tone music, we don't need to be able to identify the forms of the series. Instead, we need to hear the musical consequences of the series, the musical results of its ongoing transformations. Any musical quality or relationship preserved when the series is transformed is called an *invariant*. As we hear our way through a piece, our ear is often led via a chain of invariants.

We have already studied or alluded to a number of musically significant invariants. For example, we noticed that when you transpose a series, the succession of intervals remains the same. In other words the intervallic succession is held invariant under transposition. You don't have to be able to identify the level at which the series has been transposed to hear that the same intervals are coming back in the same order. We also discussed the subset structure of a series. That structure remains invariant under inversion and transposition. If all the discrete trichords of P_0 are members of 3–3 (014), for example, then that will also be true for the other 47 series-forms. No matter how the series is transposed or inverted or retrograded, one will be able to hear the constant presence of those subsets. There are so many different kinds of invariants that it would be impossible to give a survey here. What we will do instead is to confine our discussion to invariants under inversion and content ourselves with just two specific instances: preserving a small collection, and maintaining vertical dyads in note-against-note counterpoint.

To begin with, recall that inversion always involves a double mapping: If T_nI maps x onto y then it will also map y onto x. To take an example: $T_5I(1) = 4$ and $T_5I(4) = 1$. We can use this relationship not only for individual pitch classes, but for larger collections as well. Let's say we have within a series a