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DIGITAL MANTRAS

THE LANGUAGES OF ABSTRACT AND VIRTUAL WORLDS

Digital Mantras

The Languages of Abstract and Virtual Worlds

Steven R. Holtzman

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Western grammarians have applied grammatical and linguistic analysis to better understand and document the workings of language. However, the brahman priests not only understood the mechanics of language, they used this understanding to modify it to accord better with their notion of perfection. Deeply rooted in the Vedic belief in the power of the spoken word when spoken properly, the brahmans' objective in their study of language was to harness this mystical power.

Among all of the chants and hymns of the ancient priests, the syllable *OM* holds a special position. *OM* is said to contain the essence of the Vedas: the utmost power and mystery.

2

The Circle of Fifths

Today's musical nomenclature has developed since the time of the ancient Greeks. For example, the naming of musical notes by letters of the alphabet goes back as far as the Greeks. In fact, the word *music* itself is derived from an adjectival form of the Greek muse, one of the nine sister goddesses who presided over certain arts and sciences.

After centuries of evolution, there are many peculiarities in the nomenclature commonly used by musicians. For example, although there are twelve notes in Western music, Western musicians think of the first note of the twelve as C, and the tenth and twelfth as A and B (except in German, where the eleventh note is B and the twelfth is H). To further complicate matters, all the notes have at least two names, some as many as three. The ninth note, A \flat , can also be called G \sharp . The second note, C \sharp , can also be called D \flat and B \sharp . The distance between two notes that are seven semitones apart is called a fifth and twelve semitones apart an octave.

An early system of musical notation used from the seventh to fourteenth centuries consisted of grave and acute accents, called *neumes*, above and below a horizontal line. The notation gives merely approximate indications of the shape of a melody. The neumes follow the pitch of a chant as it rises and falls. (See figure 2.1.)

Over the next several centuries, this method of notation evolved into an elaborate system using five horizontal lines to precisely indicate pitch, and vertical lines and a set of small filled and unfilled circles matched with various tails and dots to precisely indicate duration. (See figure 2.2.)

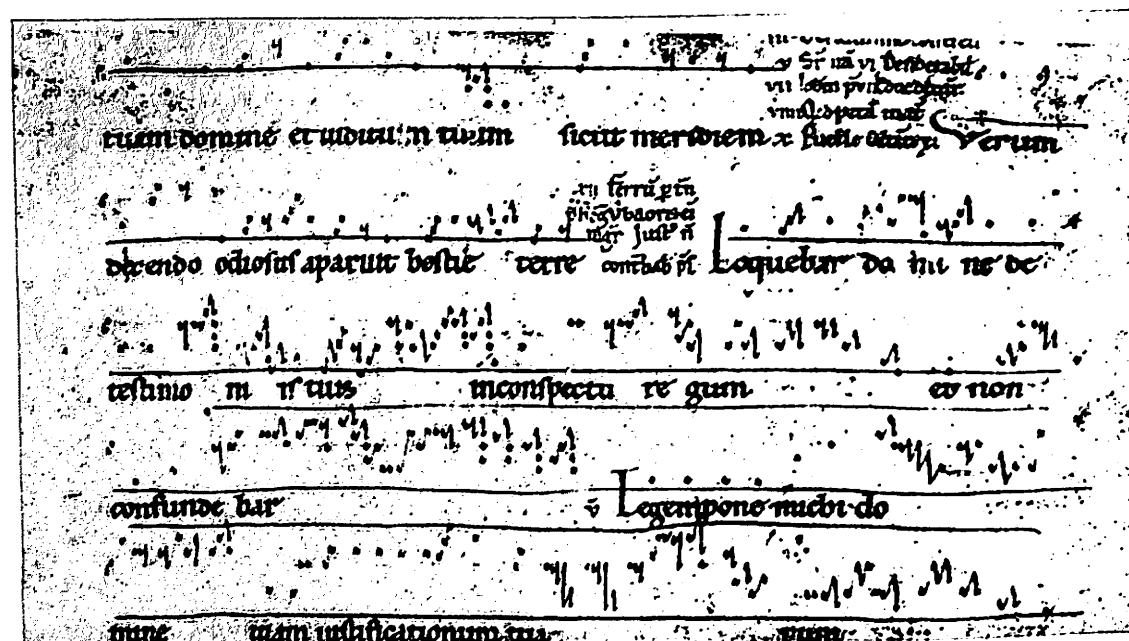


Figure 2.1

Example of notation with neumes, from a twelfth-century manuscript.

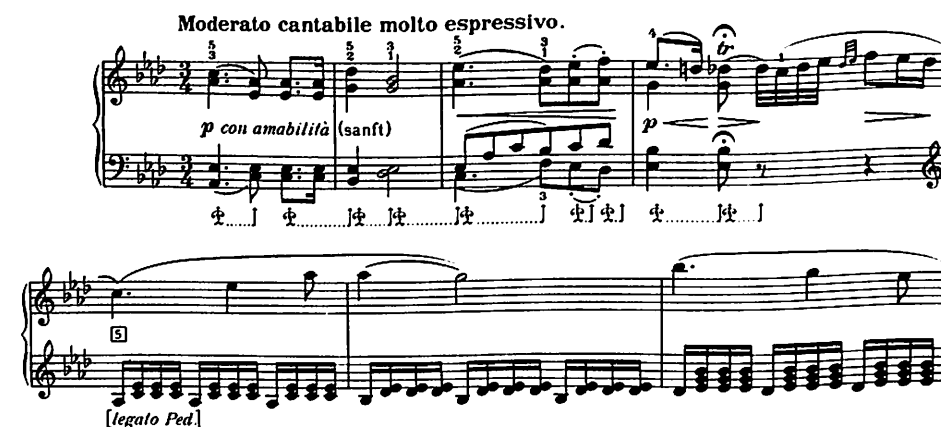


Figure 2.2

Example of nineteenth-century notation, from Beethoven's Piano Sonata in A flat, op. 110.

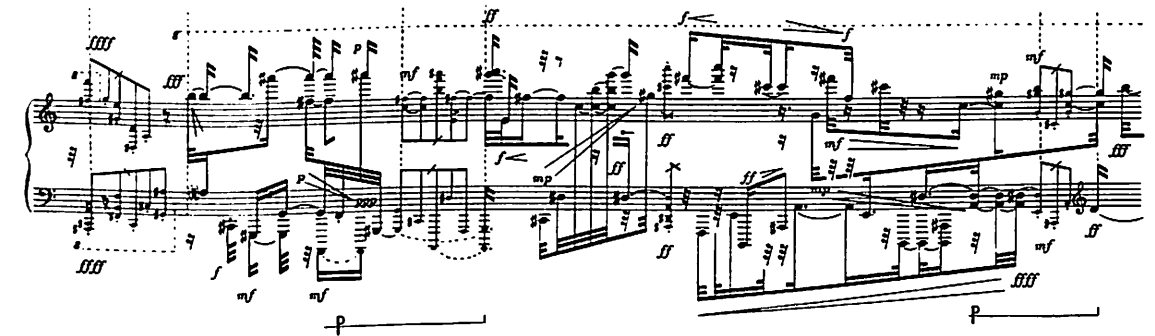


Figure 2.3

Example of twentieth-century notation, from Karlheinz Stockhausen's *Klavierstück VIII*.

The system of notation became increasingly complex as the amount of information, precision, and subtle indications composers wished to communicate grew. (See figure 2.3.)

However, when it comes to musical pitch, at least, it is possible to devise simpler notation systems. Most people don't instantly appreciate that there are seven semitones between C \sharp and G \sharp , but everyone can immediately interpret "two" and "nine." Without a second thought, everyone can automatically compute that the difference between two and nine is seven and that the sum of these two numbers is eleven.

Therefore, with the objective of making things a little easier to understand, we will put aside the notation of music by the traditional means of notes, bars, staves, and so on, and instead use a simpler and more easily understood representation with numbers. We will number and represent the twelve notes used in Western music as:

C, C \sharp , D, D \sharp , E, F, F \sharp , G, G \sharp , A, A \sharp , and B
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12.¹

To look at music and musical relationships in terms of numbers and numerical relationships does not require one to conclude that there is no more to music than numbers and numerical relationships. It can be argued that the essence of music, if not the only important aspect of music, is what it sounds like and the effects those sounds have in evoking our emotions. For the moment, however, we

will explore the formal relationships found in musical structure as they are reflected in numerical relationships.

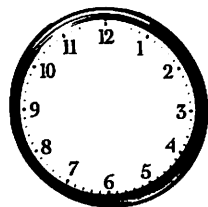
The Pythagoreans

Approximately 500 B.C., music and arithmetic were not separate in the teachings of Pythagoras and his followers. For the Pythagoreans, the understanding of numbers was thought to be the key to understanding the physical and spiritual universe. They also believed that the harmony of music corresponded to the harmony of the cosmos. Consequently, they sought to better understand the numerical relationships that underlie music in order to better understand the harmony of the cosmos.

The Pythagoreans mathematically determined the intervals between notes through the measurement of vibrating strings. They found that different intervals could be expressed in terms of the proportions of the lengths of the strings needed to achieve a given pitch. So, for example, plucking a length of string half as long as another length produces a harmonious higher pitch; they associated the relation of these two pitches with the proportion of the string lengths, 2:1. (The pitch produced by the string half as long has a *frequency* twice as high, in modern scientific terms.)²

Notes and Intervals

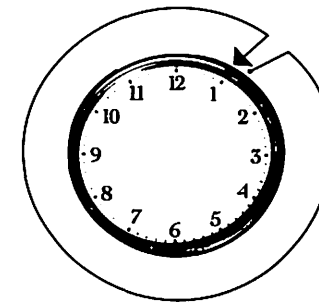
In Western music of the last three centuries, there are twelve notes. There is no thirteenth. These twelve notes can be thought of as forming a closed loop in which the twelfth note is followed by the first note. Progressing forward from 12 we arrive at 1, just as on a watch 12 o'clock is followed by 1 o'clock.



Imagine a clock without its minute hand and with an hour hand that takes only twelve discrete (and equal) steps to complete a circle. This hour hand measures time only in intervals of complete hours. With such a watch, the interval between any two times of the day is measured by the number of complete hours between them.

Rather than hours, in music the pitch interval between two notes is measured in *semitones*. The gap between 1 and 2, C and C#, for instance, is one semitone, and the interval between any two notes of the twelve can be measured by the number of semitones between them.

Moving forward twelve semitones, one makes a complete circle around the clock, arriving at the same note from which one started. This interval, a complete loop, is called an octave.



Given two notes an octave apart, the lower-pitch note vibrates at half the frequency—from a string twice the length—of the higher-pitch note, the ratio the Pythagoreans determined to be 2:1. So it isn't exactly the same note, just as one o'clock on Tuesday is not exactly the same time as one o'clock on Wednesday. However, when looking at musical relationships, it is possible to think of a complete loop around the clock, an octave, as returning you to the same note.

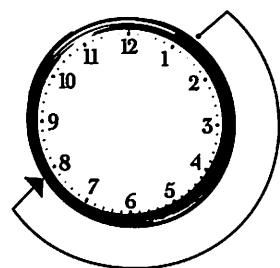
The Circle of Fifths

In studying the intervals between different notes, the Pythagoreans determined that some sounded harmonious while others were dissonant. They found a particular interval to be especially harmonious.

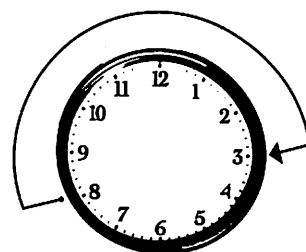
To them, it was the most beautiful. They determined that this interval was expressed as the ratio of 3:2.

This interval can also be expressed as the interval of *seven* semitones. This is a very special interval in music. It has a very fundamental role in music from the modes of Greece through Gregorian chant and the music of Palestrina, Bach, Beethoven, Wagner, Mahler, big bands, Frank Sinatra, Elvis Presley, the Beatles, and U2.

If we start with the note 1 and count seven semitones (or hours), we arrive at the note 8.



And if we count seven semitones from 8, we arrive at 3.



Interestingly, if we continue to count forward by seven in this manner, each of the twelve notes will be arrived at once before any note is arrived at a second time: 1, 8, 3, 10, 5, 12, 7, 2, 9, 4, 11, 6. Counting seven forward from 6, we arrive back at 1. This sequence of twelve notes, each seven from the previous, is called the *circle of fifths*. (Using 1 as the note C, this is equivalent to the sequence C, G, D, A, E, B, F#, C#, G#, D#, A#, E#.)

The History of Early Western Music

Most scholars say that Western music begins with the music of the Christian Church. The oldest surviving example of Christian church music was found in 1896 at the site of the ancient Egyptian town of Oxyrhynchos. It is a hymn of praise to the Trinity on a papyrus from the end of the third century. Only a few lines from the hymn can be reconstructed from the damaged papyrus. The hymn is represented in an ancient Greek notation that cannot be precisely interpreted. The exact pitches represented by the markings are not known.

Even so, we have an even more imprecise interpretation for any music that precedes the music of the Christian Church. Except for the writing of Greeks such as Aristoxenus, Plato, and Aristotle, this music is left almost entirely to the imagination. Unlike other arts that referred back to Greek art as a model, in music there was little to refer back to of a concrete nature. The musicologist Donald Grout explains:

All through the Middle Ages and even to the present time men have continually turned back to Greece and Rome for instruction, for correction and for inspiration in their several fields of work.... In literature as well as in some other fields (notably sculpture), medieval or Renaissance artists had the advantage of being able to study and imitate the models of antiquity. The actual poems or statues were before them. In music this was not so. The Middle Ages did not possess a single example of Greek or Roman music—nor are we today much better off. About a dozen examples—half of them mere fragments—of Greek music have been discovered, nearly all from comparatively late periods, but there is no general agreement as to just how they were meant to sound.³

It is difficult for us to imagine the music the Greeks wrote about, a music that was said to possess the power to influence thought and action. Likewise, we can only speculate about how and to what extent Greek, Jewish, and other Oriental music found in the eastern Mediterranean influenced the early music of the Christian Church. The only link to the music of ancient times is found between the modes of ancient Greece and the music of the Church.

The Pythagoreans, calculating various proportions and intervals, worked out several different harmonious sequences of intervals, referred to in Greek times as *modes*. A mode was defined by the order

in which intervals—roughly equivalent to the number of semitones (or hours on the watch dial)—occurred between notes. A mode could start on any note so long as the intervals and their order remained the same.

During the 1,500 years that followed the Pythagoreans, modes dominated Western music, in particular the plainsong of the Church. By the fifth century there were four *authentic modes*. During the time of Pope Gregory I, 590–604, four more were added, called the *plagal modes*. Finally, nearly 1,000 years after Pope Gregory, a Swiss monk, Henry of Glarus, proposed in his book *Dodecachordon* (1547) that there should be twelve modes rather than eight.

It was also during the time of Pope Gregory that a large collection of chants was systematically compiled, revised, and assigned to various services throughout the year. This body of chants, preserved in hundreds of manuscripts dating from the ninth century and later, is commonly referred to as Gregorian chant. What changes took place in the chant between the time of Pope Gregory and the beginning of the ninth century—the earliest date to which the present form of the melodies can be traced with any certainty—again is not known.

Gregorian chant was written using only the seven notes of a given mode. Furthermore, the chant usually went from one note to the next, rarely skipping over a note. That is, the music consisted of a string of notes that were usually one or two semitones apart, depending on the appropriate next note when moving either forward or backward by one note in the mode.

The first few hundred years of Western music were mainly occupied with the development of these chants—from simple progressions in a mode to progressions with skips and jumps. These chants were *monodic*, that is, the music consisted of only a single melodic line. Western music then evolved from simple monodic chant into more complicated musical constructions with multiple melodic lines, what is called *polyphony*.

The philosopher Karl Popper has described the development of polyphonic multivoiced music as “possibly the most unprecedented, original, indeed miraculous achievement of our Western civilization, not excluding science.”⁴ It was a development that occurred over 500 years: the evolution from the monodic church chant of the ninth

century to the great polyphonic church music of the fifteenth and sixteenth centuries.

How exactly this evolution took place is the subject of speculation. The early monodic chants were sung in church services by a congregation. It is likely that not everyone sang at the same exact pitch, but rather that they sang the same pitch at different octaves. A congregation singing would have had many voices all moving in parallel motion, but separated by octaves. Actually, it is believed that the multiple voices occurred moving in parallel at fifths apart, as well as octaves (and perhaps even other intervals such as *thirds* and *sixths*). By the tenth century, this type of doubling of voices is found in music known as *organum*. In *organum*, singing was accompanied with a doubling of the chant on an organ that, in effect, provided the reference bass for the congregation.

It is speculated that, at some point, doubling voices may not have doubled at a fixed interval. For example, rather than doubling consistently a fifth or an octave from the bass melody, voices might have switched between these, so that a voice was sometimes a fifth apart, other times an octave. Although still singing at permitted intervals from the bass melody, voices were no longer strictly parallel; thus doubling voices developed an independence. This evolved by the thirteenth century to completely independent voices. Over time, this was extended to multiple voices with greater and greater independence until, by the fifteenth century, music was heard with multiple voices—three, four, and even five and six voices—singing distinct and independent melodic lines. *Counterpoint* was born: music with distinct voices moving in relationship to a fixed melody. As this new expressive possibility was developed, formal techniques and conventions for composing counterpoint were established. (It is interesting that a basic rule of counterpoint is that motion between two consecutive parallel fifths or octaves is never permitted. The logic behind this ban is clear in this historical context. The result of such parallel sequences would have been a return to the parallel movements that characterized *organum*.)⁵

The rules of counterpoint primarily describe the permissible linear relationships between voices as they progress forward. For example, the rules require the avoidance of the interval known as the *diabolus in musica* (six semitones). Other rules define how voices cannot over-

lap, or how they may or may not move in parallel. For example, two voices cannot approach the interval of a fifth or an octave by similar motion, that is, by both moving either up or down from the previous note of each voice.

In the sixteenth century, the rules of *harmony* developed. These rules describe the permissible vertical relationships between voices, coordinating the multiple voices to ensure the avoidance of dissonance—sounds that the taste of a given time considered to be unpleasant. Although counterpoint was the dominant element of baroque music and harmony was the dominant element of nineteenth-century music, both together shape music and both are the subject of study for any student of composition.

With the development of harmony, certain intervals, sequences, and combinations of notes became more accepted than others. Over time, the modal system was abandoned. Only two of the twelve modes—those most suited to harmonic music—were still used. Today these are known to musicians as the *major* and *minor* scales. Both of these modes consist of seven notes.

These two scales, and the relationship of a *fifth*, became the foundation for Western music from the baroque period, in the music of composers such as Scarlatti, Monteverdi, Handel, and Bach, to the early twentieth century and composers such as Mahler, Strauss, and Schoenberg. This foundation has recently been reembraced by contemporary “new tonalist” composers such as Philip Glass and John Adams.

Scales

The word *scale* is derived from the Italian *scala*, meaning staircase or ladder. It is used in music to refer to a series of notes progressing upward or downward. Just like the modes that were their predecessor, a scale can start on any of the twelve notes and is characterized by the size of the intervals between notes.

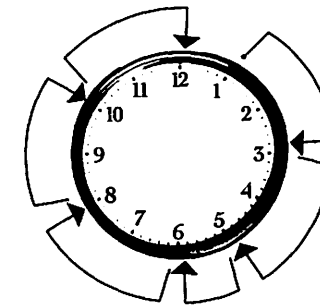
The major scale is characterized by the following sequence of semitone intervals:

+2, +2, +1, +2, +2, +2.

Given 1 as the first note of the scale, moving an interval of two semitones we arrive at 3, moving two more we arrive at 5, then moving one we arrive at 6, and so on until we derive the major scale beginning with 1:

C, D, E, F, G, A, B
1, 3, 5, 6, 8, 10, 12.

With the watch's dial, this can be illustrated by:

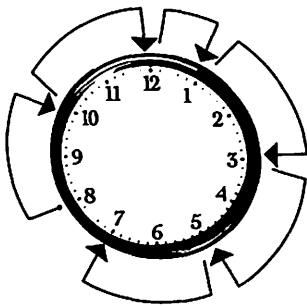


Observe that the note 8 is the fifth of the seven notes in the scale. It is because of this position in the scale that the note seven semitones from the first note of a scale is called the *fifth* note and the interval of seven semitones ($8 - 1 = 7$) is known as a *fifth*.⁶

The major scale beginning with the fifth of 1 (that is, the note that is seven semitones above 1, namely 8) can be derived in the same manner. Starting with the note 8, we again follow the intervals of the major scale to derive:

G, A, B, C, D, E, F#
8, 10, 12, 1, 3, 5, 7.

Given that a scale is defined by the series of intervals it represents and that it can begin on any of the notes, we can simply rotate the start of our previous linked series of notes in order to illustrate this scale:



Looking at these two scales, it is important to observe that all the notes of the first scale can also be found in the second, with one exception: 6. Similarly, all the notes of the second scale can be found in the first except one: 7.

1, 3, 5, 6, 8, 10, 12
8, 10, 12, 1, 3, 5, 7

This is, in fact, a general and very important property of scales and the interval of the fifth: there is only one note different between the scale of any given note and the scale beginning on the fifth of that note. It is this property that makes the relationship of a fifth so special. A note can only have this relationship (that is, a difference of only one note between its scale and the scale of another of the twelve notes) with two notes of the twelve—the note that is seven semitones from it, its fifth, and the note from which it is seven semitones, of which it is the fifth. In the case of 1, these special notes are 8, its fifth, and 6, of which it is the fifth.

Scales and the Circle of Fifths

Starting with 1, we can look at the notes of all twelve of the major scales following the circle of fifths (figure 2.4). (Recall that the sequence of the circle of fifths is 1, 8, 3, 10, 5, 12, 7, 2, 9, 4, 11, 6.) From this we see that with each step further on the circle of fifths, scales share fewer and fewer notes with the first scale of the series. Halfway around the circle, that is, six scales away, the scales begin to come closer again and share more and more notes with the initial scale. Not only is the note six semitones from any given note the furthest note, but the scale based on it is also the furthest scale—that is, the least similar.

1, 3, 5, 6, 8, 10, 12	
8, 10, 12, 1, 3, 5, <u>7</u>	1 note different
3, 5, <u>7</u> , 8, 10, 12, <u>2</u>	2 notes different
10, 12, <u>2</u> , 3, 5, <u>7</u> , <u>9</u>	3 notes different
5, <u>7</u> , <u>9</u> , 10, 12, <u>2</u> , <u>4</u>	4 notes different
12, <u>2</u> , <u>4</u> , 5, <u>7</u> , <u>9</u> , <u>11</u>	5 notes different
<u>7</u> , <u>9</u> , <u>11</u> , 12, <u>2</u> , <u>4</u> , <u>6</u>	6 notes different
<u>2</u> , <u>4</u> , 6, <u>7</u> , <u>9</u> , <u>11</u> , 1	5 notes different
<u>9</u> , <u>11</u> , 1, <u>2</u> , <u>4</u> , 6, 8	4 notes different
<u>4</u> , 6, 8, <u>9</u> , <u>11</u> , 1, 3	3 notes different
<u>11</u> , 1, 3, <u>4</u> , 6, 8, 10	2 notes different
6, 8, 10, <u>11</u> , 1, 3, 5	1 note different

Figure 2.4
The twelve major scales following the circle of fifths.

In summary, there are two special characteristics about the interval of the fifth.

(1) Moving by this interval, a sequence of notes is created in which each of the twelve notes will be arrived at once before any note is arrived at a second time. This sequence is known as the circle of fifths. (This is seen in the leftmost column of the above table.)

(2) Given the Western scales, there is a difference of only one note between the scale of any given note and the scale of its fifth. (This is seen in the difference between the successive rows of the above table.)

The History of Western Music Viewed as an Exploration of the Circle of Fifths

The 500 years of Western music between 1400 and 1900 can be viewed as an exploration of the circle of fifths, an exploration of the expressive possibilities of a system of music based on the special characteristics of the interval of the fifth. It is also an exploration of the musical structures that can be built exploiting these expressive possibilities.

As music evolved from a single voice to multiple voices, initially all the notes of all the voices were always from the same scale. Writing music using predominantly the notes of a given scale is called writing in the *key* of that scale. It was not until the early part of the six-

teenth century that *chromatic passages* began to appear in music, that is, passages in which a series of notes might include several from outside the notes of a single scale. And as composers began to use notes from more than one scale, they developed a technique, called *modulation*, for switching between the notes from one scale and those from another.

The gentlest manner of modulation is to switch to the notes of the scale beginning on the fifth of the initial scale.⁷ In this way, only one new note is introduced. However, in the sixteenth century, such a novelty would have been seen not as a subtle change in the music but rather as a bold departure into new worlds. The whole point of switching keys would have been to make a dramatic change that had to be perceived in order to achieve expressive impact in the music. The possibility of moving from one set of notes to another, of modulating from key to key, opened up new expressive possibilities for composers to explore.

At first these explorations were limited. Composers would make a quick switch to another key and then return again. And then maybe three or five switches before returning to the original key. Composers seemed compelled to develop the new expressive potential that modulation made possible.

However, these composers' adventurous explorations were not welcomed by the Church. There was a growing concern that these musical "tricks" presented too many distractions from the religious text and the content of church services. By the middle of the sixteenth century there was a strong reactionary movement to curb these deviations from the purer music of previous centuries, particularly in the context of the religious renewal of the Counter-Reformation.

Among the actions of the Council of Trent (a series of meetings held between 1545 and 1563 that codified the Counter-Reformation) was the formulation of measures for purging church music of these unwelcome deviations. A simpler form of music was prescribed. Catholic church music, it was decreed, should stick to the same set of notes. The music of the composer Giovanni Pierluigi da Palestrina was held up as the paradigm of this purer form. Palestrina's harmony represented the complete studied avoidance of chromaticism; virtually all the notes come from the same key. As a result, the music

has a quality of purity and clarity that was felt to exemplify the spirit of the mass, without distracting from its ritual and text.

However, not to be suppressed, composers soon began again to explore this new expressive resource. The most notorious of the deviant composers of the late Renaissance was Carlo Gesualdo, prince of Venosa (1560–1613). Gesualdo's first book of madrigals was published in 1594, the year that Palestrina died, also the year of Shakespeare's *Romeo and Juliet*. Gesualdo used *all* twelve notes—that is, all the notes of all the scales—in his music. Though the madrigals were secular music and, therefore, were not subject to the Church's prohibition, he also wrote intense church music in this style.

Gesualdo was part of a school of experimental composers in northern Italy that explored sequences and combinations of notes that would not be heard again until 300 years later in the music of Wagner. If not for his extraordinary experiments that resulted in a profoundly expressive music, Gesualdo is remembered as a jealous husband who axed his wife and murdered her lover.

Tonality as the Basis for Structuring Music

Tonality, the use of the fifth and traveling the circle of fifths, became the basis for *structuring* compositions. In Walter Piston's classic text on harmony, he explains:

Tonality, then, is not merely a matter of using just the notes of a particular scale. It is more a process of setting forth the organized relationship of these notes to one among them which is to be the tonal center. Each scale degree has its part in the scheme of tonality, its tonal function.⁸

The use of keys and modulations shaped the form of a composition. Tonality organized the flow of the music.

As a composition unfolded, composers began to switch from one scale, or key, to another closely related scale and would conclude the composition by returning back to the original scale. The easiest way to do this was to move from the original key to the key of the fifth of the original key. During the course of a composition, a composer could subtly introduce an extraneous note, the note that distinguishes the scale of the fifth from the original scale, and then drop the note of the original scale that isn't found in the scale of the fifth.

In this manner, the key of the composition would change from the original to the key of the fifth.

Composers became more and more daring as they searched for new means of expression. They would not only switch to the key of the fifth, but move around the circle in the other direction to the key to which the original key was the fifth (though still only one note away). By the seventeenth century, the European courts shared the patronage of Western music with the Church; many secular patrons welcomed such harmonic experimentation. The doors were open to study just how great the scope of a structure built on tonality and the circle of fifths could be.

Throughout the eighteenth and nineteenth centuries, the major-minor tonality was the dominant underlying support of music. By this time, all the harmonies of a composition were organized in relation to the base key, called the *tonic*, with temporary modulations to other keys. An explicit theoretical foundation was described in Rameau's *Treatise on Harmony*, published in 1722, but this type of tonal organization had already been in use for at least 40 years and had been foreshadowed in the music of the Renaissance, especially that written in the latter half of the sixteenth century.

New forms extended into large musical structures using new techniques built on tonal organization with a clear "tonic-dominant" (that is, first-note-to-its-fifth) relationship. Grout explains the development of music based on this relationship.

The final perfection of the fugue, as well as of all the other large musical forms characteristic of the late Baroque, was inseparable from the full development of the major-minor system of tonality with its hierarchy of keys, which made possible a systematic use of key relationships in the musical design of long movements.⁹

From this time until the early twentieth century, periods of music can be seen as the exploration of structures extending further and further around the circle of fifths.

Mozart and Haydn explored the fifth of the fifth to the fullest. Both of the best-known musical forms of this classical period—the sonata and the symphony—are, again, based on the first-note-to-its-fifth relationship. Generalized very simply, both begin with the exposition of a theme in the base key. Then a second theme is introduced

in the key of the fifth. After this formal introduction of the themes, the bulk of the movement consists of *developing* various relationships between the themes and different keys. Ultimately, the movement concludes with the first and second themes both played in the initial key of the movement. This overall structure of a movement is known as *sonata form*:

Theme 1 (in the base key), Theme 2 (in the key of the fifth),
Development of themes (with modulations to various keys),
Theme 1 (in the base key), Theme 2 (in the base key).

Beethoven explored the fifth of the fifth of the fifth and beyond. After his Symphony no. 3, *Eroica*, with its extended development sections, the development section assumed prime significance in a musical structure. Themes were transformed and combined to explore the full potential of the harmonic and melodic universe. Schumann and then Brahms, Wagner, Bruckner, and Mahler each went a step further. The explorations became even more extensive and the compositions grew in size and complexity throughout the nineteenth century, culminating in the massive works of Wagner, Bruckner, and Mahler.

The explorations progressed further and further along the circle of fifths until, hearing a note, one could not determine to which set of notes it related. The original set? The set of notes of the fifth? The fifth of the fifth? The fifth of the fifth of the fifth? Ultimately such descriptions seemed as contrived to a musician or composer as they seem nonsensical to a nonmusician. And they are. The context of any given set of notes changed so frequently that any note could appear at almost any time. Effectively, all twelve notes were equal. The progression of notes and the relationships from which they may have been derived were so difficult to determine, and were obscured by such complex and rapidly changing underlying harmonies, that the tonal structure of the music was virtually unintelligible. The harmonic structures that had been the basis of Western music for centuries collapsed. They were no longer used to build musical structures.

The whole course of late romantic music, especially in Germany, tended to this collapse of tonality as the underlying structure of music. The dissolution of classical tonality begins in the works of

Schubert and Chopin and continues in the works of Liszt. Melodies and chord progressions using all twelve notes and in which no tonal center or underlying set of notes can be perceived began to appear in the work of Wagner and Strauss.

At first these passages were unusual and rather short. But by the early twentieth century, in the works of Strauss and Mahler, the experiments became bolder and the explorations longer. Schoenberg explored the extreme possibilities of using all twelve notes within the limits of tonality in *Gurre-Lieder* and his String Quartet no. 2. Finally, he cut loose altogether from a key center. In his *Pierrot Lunaire*, rather than regarding some notes as alien to the original key, he treated all twelve notes as of equal rank.

Conclusion

For 500 years tonality was the basis for *structuring* music. It was the foundation for musical form, the rationale for the relationships between the notes of a composition.

The interval of the fifth is at the very foundation of tonality. The first and fifth notes of a scale are the anchors in the harmony of tonal music. And it is the circle of fifths that provides the framework for building larger musical structures.

But for early twentieth-century composers, inheritors of these harmonic traditions, tonality was no longer effective as a structuring device for creating a piece of music. Music was faced with a great challenge; some other device was needed.

Some composers experimented with new approaches to tonality. Debussy, Ravel, and others experimented with exotic alternatives to traditional tonality, using modes and the pentatonic, whole tone, and other nontraditional scales and chords. Busoni and Strauss, who influenced Hindemith and Weil, developed a new simplicity that was intended in some ways as a return to Bach. Others, such as Stravinsky and Bartok, created an entirely new aesthetic driven by rhythm and folk melody.

Still others, such as Schoenberg, Webern, and Berg, found themselves virtually unable to write music. These composers, one day to be seen as innovators by the post-World War II avant-garde, were in a sense the ultimate traditionalists. They clung to traditional tonality

as their basis for writing music; with its collapse in the early years of this century, their works became mere 20-second compositions. The massive musical structures that characterized the works of Wagner, Bruckner, Strauss, and Mahler at the turn of the century collapsed into small musical fragments. Without the logic and structure of harmony, every note written was the result of a difficult struggle to follow one note with another.

4

The Second Viennese School

Through the first decade of the century, Arnold Schoenberg found the composition of extended works to be more and more difficult. His music was deeply rooted in the traditions of tonality. Without tonality as a basis for writing music, his compositions were increasingly sustained purely by direct emotional expression without the support of traditional musical structures. However, Schoenberg eventually exhausted this draining source of inspiration. Finally, by 1917, he was no longer creating any new compositions.

Schoenberg published no music for several years, but he returned to the music scene in 1923 with new ideas. He had developed a new foundation for composition that could replace tonality, a "method of composing with twelve tones which are related only with one another." In Schoenberg's method, each of the twelve notes of the scale is equal in importance to the others. He proposed that the twelve notes could be ordered in a unique *series* that could be thought of like a theme and used as the core material for a composition. Schoenberg went on to suggest that the twelve notes should be ordered so that each note occurs once and only once in the series. In a composition, the notes of the series would be used in the order they occur in the series, over and over and over.

There was a new method to determine the relationships of the notes of a piece. Using the same series of notes over and over for an entire composition provided a means for unifying a complete work, analogous to the role tonality had played before. The role of each note was determined by its position within a series, and the role of a given occurrence of the series was determined by its position

within the larger structure of the composition. In analyzing a composition, *every* note could be numbered as the *n*th note of the *y*th occurrence of the series.

Schoenberg's method of composition is known as *serialism*. It was to be extremely influential in musical thought for the 40 years that followed his first works using this method in the early 1920s. Schoenberg and two disciples of his new musical doctrine, Alban Berg and Anton Webern, established a foundation for a new music.

Mozart, Beethoven, and Schubert, the great masters of classical music, had lived in Vienna between 1780 and 1830. Schoenberg, Berg, and Webern, who were also centered in Vienna, are often referred to as the *Second Viennese School*.

Arnold Schoenberg

This invention of a new technique was made not by a radical young innovator but by a man who, in 1923, was 49 years old. Nor was this seemingly mechanical and mathematical system for writing music invented by a man obsessed with abstractions and divorced from life. Rather, Schoenberg is described as having been a "fiery-tempered, hoarse-voiced, chain-smoking, bald-headed little man, this dynamo of nervous energy ... the battleground of barely governable emotions."¹ He lived in Vienna at a time when a collection of brilliant individuals in a broad array of disciplines—including Sigmund Freud, Ludwig Wittgenstein, Adolf Loos, and Oskar Kokoschka—each found a need to rethink the basic language of their disciplines.

Schoenberg had begun playing the violin at the age of eight or nine and composing soon after. But his parents were not particularly interested in music. His family belonged to the poorest level of the petite bourgeoisie; his father owned a small shoe shop and hoped Arnold would become an engineer. When his father died, he had to begin work at 15 as a clerk in a bank to support his family. Finally, five years later in 1895, the bank went bankrupt and Schoenberg committed himself to composition in spite of his family's lack of enthusiasm.

In 1897, Schoenberg's String Quartet in D Major became his first piece to be publicly performed. It was well received: "It seems to me that a new Mozart is growing up in Vienna."² His musical language

developed rapidly. Two years later, he wrote *Verklärte Nacht* (Transfigured Night), which met a cooler reception. This was modern music that went beyond Wagner in chromatic intensity.

In 1901, Richard Strauss, Germany's most recognized living composer, was impressed by Schoenberg's next work, *Gurre-Lieder*. Strauss helped Schoenberg find work and encouraged his compositions. In 1903, upon hearing *Verklärte Nacht*, the Austrian composer Gustav Mahler also became a staunch supporter.

However, Schoenberg's works found increasingly unreceptive public audiences. By 1908, a performance of his String Quartet no. 2 was met with whistling, jeers, and catcalls. A review of this concert politely concluded that the composer was "tone-deaf and thus, musically, *non compos*."³ Although audiences were impressed by the intensity of his compositions, they were baffled by the distant explorations of tonality and chromaticism.

In his personal life Schoenberg was experiencing intense distress. In 1908, his wife Mathilde had moved in with an expressionist painter and teacher named Richard Gerstl, nine years Schoenberg's junior. Schoenberg pleaded with her to return to him and their family. She left Gerstl, who killed himself shortly thereafter at the age of 25.

In the years following 1908 and preceding the outbreak of war, Schoenberg wrote *Erwartung*, *Pierrot Lunaire*, and other milestone compositions. These works are often described as "expressionist" music, which, like expressionist painting, was considered to be a direct reflection of troubled psychological states. Schoenberg wrote in a letter of 1910, "Art is the cry of distress uttered by those who experience at first hand the fate of mankind."⁴ (During this same period, Schoenberg undertook painting in the expressionist style. Three of his paintings were included in the first *Blaue Reiter* exhibition in Munich, with works by Wassily Kandinsky and Franz Marc.)

Schoenberg's intense emotional state resulted in free-form streams of intense, feverish music. His instrumental works virtually stopped; all of his major works were now vocal works, where the text helped shape the flow of musical events. His compositional language evolved to one of complete chromaticism, freely using all twelve notes. His works had no solid tonal foundation; his direct emotional expression propels them from their first note to their last. Schoenberg described his music of this period in a letter to Richard Strauss as "without

architecture, without structure ... an ever-changing, unbroken succession of colors, rhythms and moods."⁵ (At this same time, Strauss found Schoenberg's music to be incomprehensible and described it to others as the work of a man needing psychiatric care.)

In the years just before World War I, Schoenberg found that he could no longer compose works driven purely by his intense emotional energy. Between 1913 and 1922 he completed only one ten-minute work, his *Four Songs* (opus 22). With a compositional language of complete chromaticism without tonal support structures, and having exhausted the emotional expressiveness of a few years earlier, Schoenberg now had no basis from which to compose.

Finally, between 1920 and 1923, he formulated his theory of composing with twelve notes. His first composition to use a complete series of twelve notes was the fifth of his *Five Piano Pieces* (opus 23), from 1923. This was followed by the serial compositions *Serenade* (opus 24) and *Suite for Piano* (opus 25). Schoenberg was liberated to compose again. He found a new basis for composition, a new musical logic. He wrote in 1923, "I find myself positively enabled to compose as freely and fantastically as one otherwise does only in one's youth."⁶

The Series

The circle of fifths is an example of a series. Each of the twelve notes in the circle occurs once before any other is repeated.

Circle of fifths: 1, 8, 3, 10, 5, 12, 7, 2, 9, 4, 11, 6

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

A serial composition using the series of the circle of fifths would repeat the notes of the circle in order. Serialism, however, was to become the basis for *new* music languages. The circle of fifths represents the very essence of tonal music. It is, therefore, not the most appropriate series to illustrate the serial composition process. It is also not appropriate due to its simplicity—all the intervals between successive notes are of seven semitones. Such simplicity is uncharacteristic of how serial techniques were generally used.

The series from Schoenberg's opus 23, the first serial composition, is more suitable.

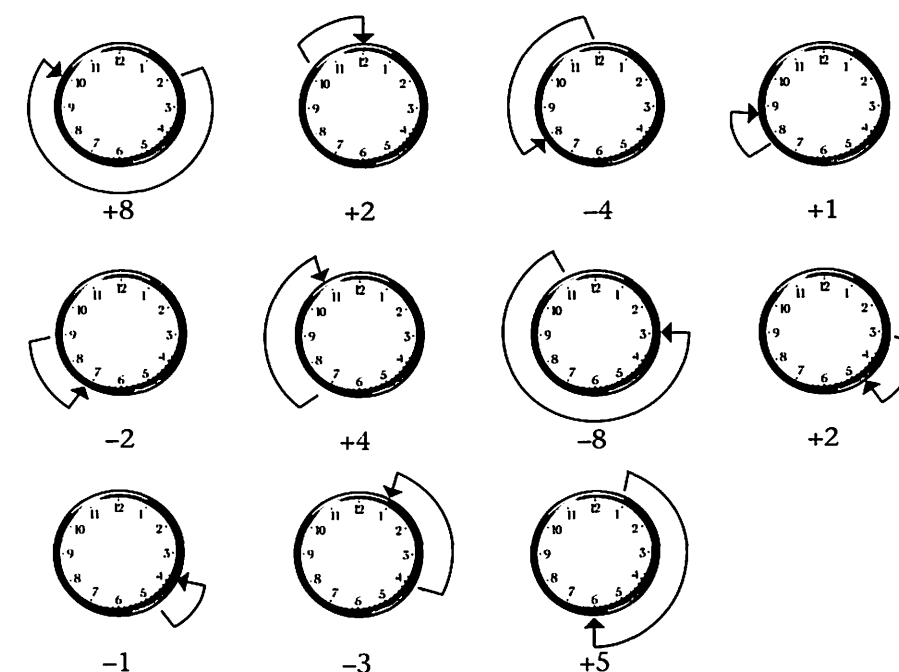


Figure 4.1

Moving on the clock's dial by the intervals of the opus 23 series.

Opus 23 series: 2, 10, 12, 8, 9, 7, 11, 3, 5, 4, 1, 6

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

Looking at this series, we see that the intervals are not always a fifth, +7. They are +8 (i.e., $10 - 2$), then +2 (i.e., $12 - 10$), then -4, +1, -2, +4, -8, +2, -1, -3, +5. (See figure 4.1.)

The particular sequence of notes that forms a given series is entirely the choice of the composer. And, as the series is a basic building block, the composer's choice of a series shapes the overall composition. In this way, the series functions somewhat like a traditional theme in music.

One can imagine that a composition where twelve notes are repeated over and over might become a little dull. However, Schoenberg's system allowed a number of transformations of the twelve notes in the series. The notes could be played forward, backward, upside-down, or backward and upside-down—the same four transformations used with themes and motifs by Machaut 600 years earlier, by Bach 200 years earlier, and by Beethoven 100 years earlier.

Furthermore, the series could be transposed to start on a different note while maintaining the same structure, that is, while maintaining the same sequence of intervals between the notes. This transformation is just like the transposition of a scale—also a technique common in music for hundreds of years.

A serial composition, then, becomes like a perpetual variation on the series. There can be up to 48 different manifestations of the series, each of the four transformations—forward, backward, upside-down, and backward and upside-down—being possible with the series beginning on any of the twelve notes. In addition, there was scope to vary rhythm, dynamics, timbre, orchestration, texture, and so on.

A new musical language was born. Nonetheless Schoenberg's ideas on music should not be seen as a total break with tradition. They are in fact an evolution following from the collapse of tonality, and his techniques of manipulation are well grounded in traditional music techniques. Given the extreme complexity of turn-of-the-century chromatic music, with musical structures in which no tonal center was actually *perceptible*, it was a logical progression to abandon keys, tonal centers, and harmonic progressions altogether. Rather than regard notes as chromatically altered in a complex scheme of relationships between fifths of fifths of fifths or whatever, it made sense to simply treat all twelve notes as of equal rank.

The Four Versions of a Series

Using Schoenberg's series, let's look at the four different versions of the series: the original (forward), backward, upside-down, and backward and upside-down.

The starting point is the original series.

Original

Opus 23 series: 2, 10, 12, 8, 9, 7, 11, 3, 5, 4, 1, 6

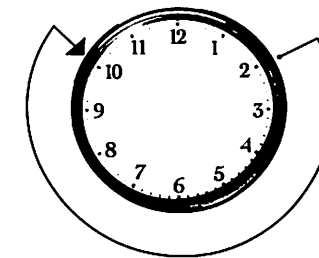
This series is then subjected to a number of transformations in order to derive the other versions of the series.

From the original, it is easy to create the backward version of Schoenberg's series:

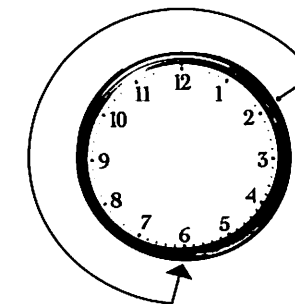
Backward

Opus 23 series: 6, 1, 4, 5, 3, 11, 7, 9, 8, 12, 10, 2

The transformation of the original to derive the upside-down version is more involved. In music, playing something "upside-down," also called inversion, is defined in terms of intervals. We can use the analogy of the watch's dial to illustrate this. If the original interval moves *forward* 8 notes on the clock, from 2 to 10:



then the inversion moves *backward* 8 notes, from 2 to 6:



Given a set of intervals, the process of inversion consists of changing each + to - and vice versa. The same intervals are heard in the same order, but in the other direction. Given that the intervals from the original opus 23 series are:

+8, +2, -4, +1, -2, +4, -8, +2, -1, -3, +5,

those of the inversion are:

-8, -2, +4, -1, +2, -4, +8, -2, +1, +3, -5.

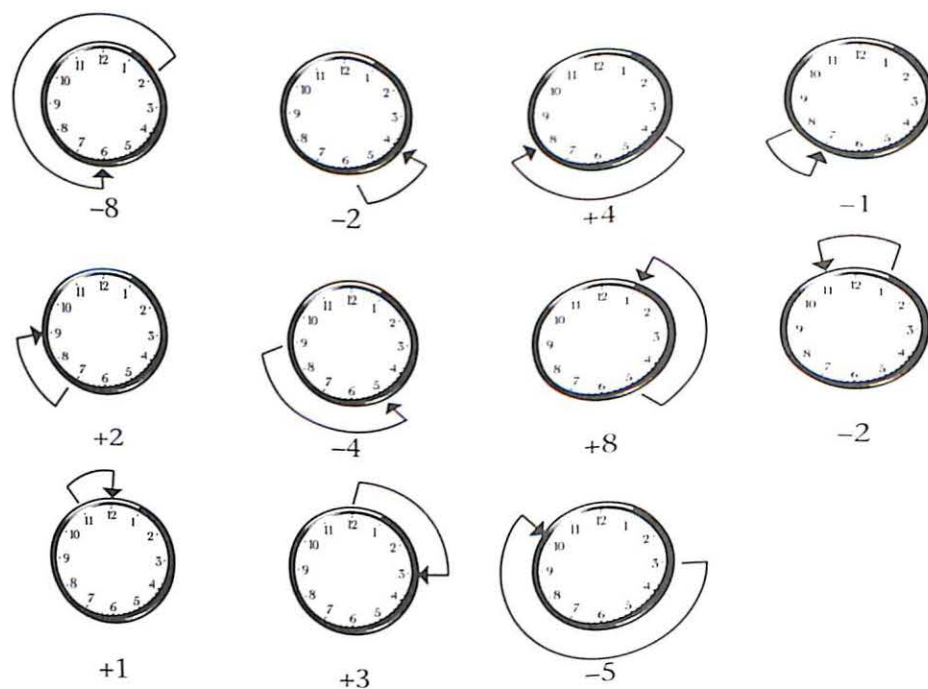


Figure 4.2

Taking the intervals of the opus 23 series and going in the other direction.

Applying the latter intervals starting from the first pitch of opus 23, we derive the inversion or upside-down version of Schoenberg's series. (See figure 4.2.)

Original

Opus 23 series: 2, 10, 12, 8, 9, 7, 11, 3, 5, 4, 1, 6

Upside-down

Opus 23 series: 2, 6, 4, 8, 7, 9, 5, 1, 11, 12, 3, 10

To perform the transformation of the series to backward and upside-down, we start with the backward version of the original series:

Backward

Opus 23 series: 6, 1, 4, 5, 3, 11, 7, 9, 8, 12, 10, 2

We can see that the intervals are

-5, +3, +1, -2, +8, -4, +2, -1, +4, -2, -8.

The upside-down version of the backward version of the series inverts the intervals of the backward series, so that the intervals of the backward and upside-down series are:

+5, -3, -1, +2, -8, +4, -2, +1, -4, +2, +8.

Starting with note 6 and applying this sequence of intervals, we arrive at the backward and upside-down version of the series:

Backward upside-down

Opus 23 series: 6, 11, 8, 7, 9, 1, 5, 3, 4, 12, 2, 10

In summary, there are four versions of the Schoenberg series.

Original

Opus 23 series: 2, 10, 12, 8, 9, 7, 11, 3, 5, 4, 1, 6

Upside-down

Opus 23 series: 2, 6, 4, 8, 7, 9, 5, 1, 11, 12, 3, 10

Backward

Opus 23 series: 6, 1, 4, 5, 3, 11, 7, 9, 8, 12, 10, 2

Backward upside-down

Opus 23 series: 6, 11, 8, 7, 9, 1, 5, 3, 4, 12, 2, 10

The Late Years

Schoenberg had developed a new system for writing music that effectively rid twentieth-century European musical tradition of its tonal basis for musical structures. Yet Schoenberg's music was still deeply rooted in the structure of classical music. He combined his new system for deriving the notes of a composition with musical forms that were traditional, like canons, minuets, and so on. Themes are recognizable, the rhythmic pulse has a classical feeling. The works have shape, direction, and a sense of climax and release. The music still sounded like a part of classical tradition, and it was. Consequently, Schoenberg—the inventor of a technique that was to radically change music in the twentieth century—has been rejected by audiences tuned to the tonal traditions of the nineteenth century as too progressive and by the avant-garde of the postwar years as too conservative.

In July 1921, Schoenberg declared to a friend, announcing his discovery of a new compositional system, "Today I have discovered something which will assure the supremacy of German music for the next hundred years."⁷ In 1933, he was forced to leave his teaching post at the Berlin Academy as part of the Nazi purge of Jewish elements from German culture.

His brother Heinrich was killed by injection in a Nazi hospital. His cousin Arthur died in a concentration camp. Several of his pupils met violent deaths in the Holocaust. He himself escaped and spent his last years in the United States, frequently ill and living in cultural isolation in southern California. He died in 1951.

Alban Berg's Serialism

Alban Berg began his studies with Schoenberg in 1904, at the age of 19. He has emerged as the composer of the Second Viennese School with perhaps the widest audience; among his works are the twentieth century's two greatest operas, *Wozzeck* and *Lulu*.

Berg's explorations of serialism were imbued with a passionate and emotional feel that was not unlike the music of the late romantics in spirit. As a result, his music is warmer and more humane than Schoenberg's. However, the underlying process of compositions such as *Lulu* and the *Lyric Suite* was serialism, not tonality.

Berg's first serial composition in 1925 was a setting of a poem. The series from this setting was also used in the first movement of his next work, the *Lyric Suite* for string quartet. The series is:

Lyric Suite series 1: 6, 5, 1, 10, 8, 3, 9, 2, 4, 7, 11, 12

Looking closely at the intervals of the first six and second six notes of the series, one sees that the series is *symmetrical*. The second six notes are the backward and upside-down version of the first six.

-1, +8, -3, +10, -5, +6, +5, -10, +3, -8, +1.

As a result, the backward and the backward and upside-down versions of the series are identical with the original and upside-down versions (though six notes are transposed).

The *Lyric Suite* has two other series in other movements of the quartet. These are:

Lyric Suite series 2: 6, 1, 8, 3, 10, 5, 12, 7, 2, 9, 4, 11

Lyric Suite series 3: 1, 3, 5, 6, 8, 10, 7, 9, 11, 12, 2, 4

It's also interesting to take a look at the intervals of these two series.

The intervals of the second series are:

-5, +7, -5, +7, -5, +7, -5, -5 +7, -5, +7

The second series is the circle of fifths, starting on 6! (Keep in mind that the intervals of -5 and +7 are effectively the same—from any given point on the clock, whether you go forward +7 or backwards -5 you will arrive at the same note.)

The intervals of the third series are:

+2, +2, -1, +2, +2, -3, +2, +2 +1, +2, +2

As with the first series, with both these series the backward and backward and upside-down versions of the series are the same as the original and upside-down versions. Upon further inspection, one notices in addition that the set of the first six notes (1, 3, 5, 6, 8, 10) and the set of the last six notes (2, 4, 7, 9, 11, 12) of *all three series* are the same sets of notes, just ordered differently. All three series share the same two *hexachords*, that is, the same two sets of six notes. All of these ties form a basic web of relationships that create the building blocks and unity of the composition.

Berg's serial works are characterized by the use of a series mixed with nonserial passages and movements. Sometimes he would use more than one series in a movement, which Schoenberg did not do. And, as in the *Lyric Suite*, his series had no backward or backward and upside-down versions.

These are characteristics of Berg's rigorous and systematic, if idiosyncratic, manner of using serialism as the foundation for his work. And although the formal structure may not have been based on the rules of tonality, Berg, like Schoenberg, continually merged the two worlds, with compositions built on series somewhat paradoxically based on the very roots of tonality: major and minor chords, the circle of fifths, strong tonal centers, and so on.

Even in his last work, the Violin Concerto written in 1935, Berg uses his series in such a way that all of the instruments are playing fifths, that very fundamental interval of tonal music. It opens with the clarinet and harp doubling one another playing fifths:

Clarinet —, 6, 1, 8, 8, 1, 6

Harp 11, 6, 1, 8, 8, 1, 6

The concerto continues with a solo violin, also playing fifths, alternating with the doubling clarinet and harp.

Berg died at 50 on Christmas eve, 1935, of an infection related to an insect sting.

Anton Webern's Music

The music of Anton Webern represents a totally different direction in the exploration of serialism. Webern's works were of extreme economy and concentration.

Webern also began his studies with Schoenberg in 1904 and was an enthusiastic supporter of Schoenberg's ideas. Beginning at the limits of tonality in the style of the turn of the century, Webern found intense economy a necessity given the difficulty of building larger structures without a tonal foundation. By 1910, his works were brief sequences of fleeting aphoristic gestures. His concision resulted in complete works that consisted of the statement of only a few motifs, chords, and ostinatos. He avoided repetition. Webern said, "While working I had the feeling that once the 12 notes had run out, the piece was finished.... This may sound incomprehensible, but it was immensely difficult."⁸

The results were compositions, such as his *Five Pieces for Orchestra*, in which each piece or movement lasts less than one minute. The fourth of the *Five Pieces* is the closest he came to a twelve-note composition—it had 27 notes, counting repeated attacks of the same note as a single note. (Although the first twelve notes present each note of the semitone scale once and only once, this composition is not serial.) Figure 4.3 shows the *complete* fourth movement—all 27 notes!

Two phrases pass fleetingly, the first played by the mandolin, the second by the trumpet and trombone. A single chord played by the harp accents the mandolin phrase. The viola and clarinet each play a note softly in the background while the brass "sweetly" sing the second phrase. The piece slows down as it already begins to conclude. Several different instruments each softly repeat notes, as if echoed, as the piece ends with a phrase played by the violin. Every

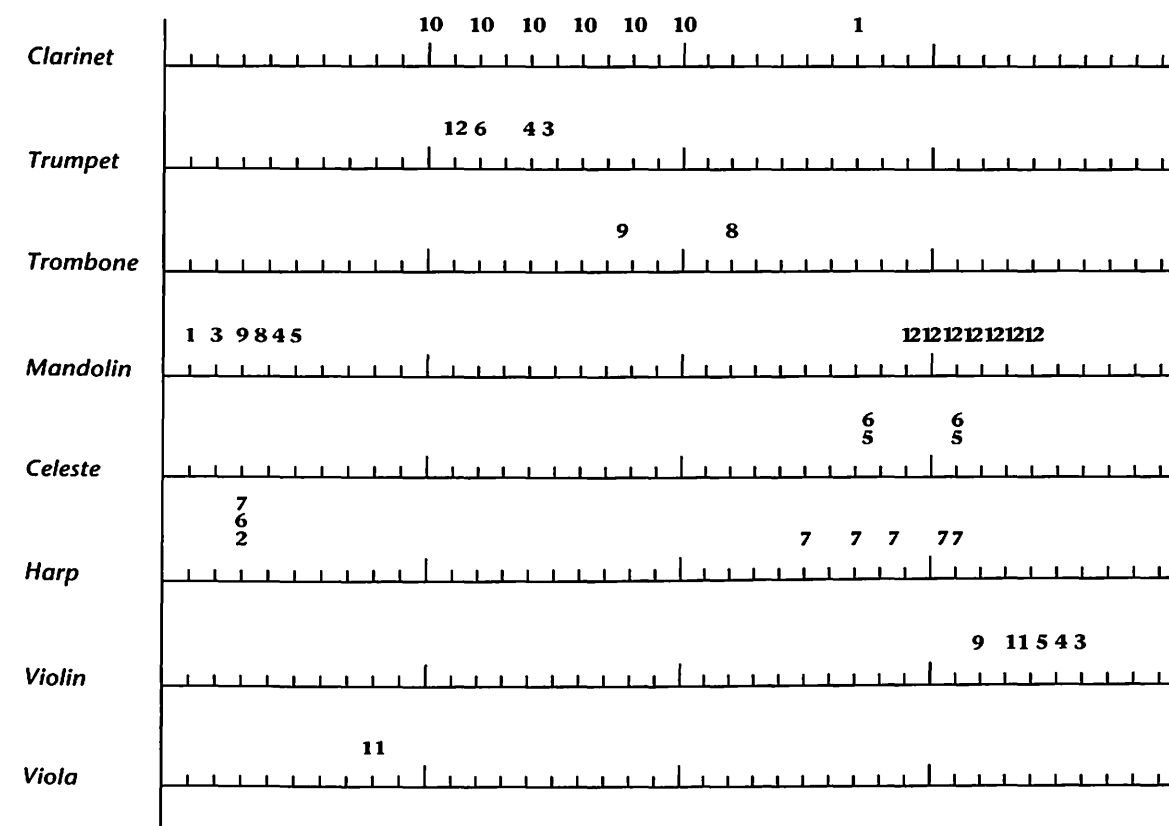


Figure 4.3

Transcription of the complete fourth movement of Webern's *Five Pieces for Orchestra*, op. 10, no. 4.

note is played softly (*p*), very softly (*pp*), or very very softly (*ppp*). There is no rhythmic pattern. The orchestration varies from phrase to phrase and even from note to note. The one-minute movement leaves a disembodied ghostly impression.

Another example of Webern's compressed compositions is found in his *Three Pieces for Piano and Cello* (opus 11) from 1914. This work lasts 2 minutes and 30 seconds. Every note on the piano uses either a different attack or a different dynamic. Every phrase of the cello uses a different type of tone production. It has a Zen-like concentration where every detail and every gesture are significant.

By 1914, Webern, like Schoenberg, found it difficult to compose without using a text as the basis for the compositional structure. For ten years, Webern composed only vocal works; only in 1924 did he return to purely instrumental music, after Schoenberg had introduced

the compositional methods of serialism. Webern's first serial composition, and first instrumental work since 1914, was the tiny *Kinderstück* for piano, a simple exercise in serialism with the series repeated always in the same form.

Webern did, however, develop complicated and intricate serial works. For example, the series in his *Concerto* (opus 24) is built from four groups of three notes, where each group is a different version of the original three notes.

Concerto (opus 24)

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

Using the first three notes as the original set, a sort of miniseries, there follow the set backward (and transposed), then backward and upside-down, and lastly just upside-down. The intervals found between the three notes of each set show this clearly:

1st set (12, 11, 3): -1, +4

2nd set (4, 8, 7): +4, -1

3rd set (9, 5, 6): -4, +1

4th set (1, 2, 10): +1, -4

Webern's brevity and concision remained even after his total adoption of serialism. (Unlike Schoenberg and Berg, he never composed a nonserial work after 1924.) With only one early exception, he wrote no compositions of more than five minutes. His entire oeuvre can be heard in four hours.

Webern's works represent a new language, a new approach to music. He was not a tonal composer using serialism to create quasi-tonal compositions. Whereas Schoenberg and Berg still fell back on their classical and romantic roots to compose, and their music feels like an extension of that tradition, Webern's broke with it. Schoenberg used classical forms, such as the minuet, complete with frequent repetition, traditional rhythmic structure, and Brahmsian orchestration. Webern's music is concentrated without repetition, without rhythm, and without traditional orchestration.

Webern died on September 15, 1945, after being shot in error by an American soldier just after the war. He became the hero, and his music the departure point, for young composers looking to develop new musical languages after World War II.

Conclusion

Tonality, rooted in the circle of fifths, was a highly formal foundation that dominated the composition process for centuries. The formal basis of tonal music was explicitly understood and extensively analyzed, discussed, and studied. Numerous treatises were written on harmony and counterpoint. One of the best known is J. S. Bach's last work, *The Art of Fugue*, written between 1749 and 1750 but never completed. In it, Bach takes a theme and plays it backward, upside-down, and backward and upside-down. He also demonstrates a number of other very formal manipulations of musical material. Studying *The Art of Fugue*, one develops a clear understanding of the abstract nature of musical structures and the almost mathematical nature of the musical techniques of harmony and counterpoint.

Serialism is also a highly formal foundation that has had a major influence on composers for much of the twentieth century. Schoenberg's techniques are formal and explicit. They can also be understood in terms of an abstract system, and the mathematical nature of the techniques of serialism should be apparent.

All music can similarly be viewed as a formal abstract system. Even music that may seem like noise or that is based on randomness and chance must have an underlying system. To the extent that music is a form of communication between composer and listener, it must have an underlying shared set of rules that makes communication possible.

With the end of the war in 1945, the banner of serialism was left to be carried by a new generation. Schoenberg was ill, living in cultural isolation in southern California. Webern was dead. Berg had died in 1935. Schoenberg, Berg, and Webern had developed the foundation for a new musical language.

Serialism dominated European musical thinking in the years following World War II. In the aftermath of the war, many young composers wanted a new beginning. Serialism was seen as "pure" and rigorous. Banned by the Nazis, its acceptance was also a repudiation of the Nazis. Serialism was to be the foundation for their search for a new music language. A young Frenchman, Pierre Boulez, was the leader of this search.

Schoenberg was not a rebellious youth at the time he invented serial composition. However, in 1945, when Pierre Boulez heard serial music for the first time, he was rejecting much of his cultural heritage. He had abandoned Catholicism and attended meetings of the Communist Party. He mocked the grand music of the past with distorted performances on the piano.

Boulez led a group of Paris Conservatory students in booing the French premiere of two works by Igor Stravinsky. Stravinsky's work, branded by the Germans as decadent, was celebrated in postoccupation Paris, but to Boulez it represented neoclassicism rooted in the music of the past. Boulez proclaimed that the musical life of the past would not return, that neoclassicism was dead, and that he would search for a new language.

Serialism was to be at the core of this new language. For Boulez, the experience of hearing serial music for the first time was "a revelation."

Here was a music of our time, a language with unlimited possibilities. No other language was possible. It was the most radical revolution since Monte-

verdi, for all the familiar patterns were now abolished. With it, music moved out of the world of Newton and into the world of Einstein. The tonal idea was based on a universe defined by gravity and attraction. The serial idea is based on a universe that finds itself in perpetual expansion.¹

Pierre Boulez

Boulez had studied with Olivier Messiaen at the Paris Conservatory in 1944. Messiaen, a very influential French composer, approached composition from a nontraditional orientation. He wrote music based on medieval modes and Gregorian melodies rather than traditional tonal harmony; he was a specialist in Asiatic rhythms; and he was fascinated by exotic bird songs and based complete compositions on his transcriptions of them. In the extremely conservative world of the Paris Conservatory, he was a maverick whose classes provided a forum for experimentation and exploration. Although Boulez would later deny it, Messiaen was the first major influence on him as a composer.

It was only a year later that Boulez discovered the German serialist composers and experienced his "revelation." Among these composers, he quickly rejected Schoenberg and embraced Webern. "I had discovered elaborate rhythms through both Messiaen and Stravinsky. Webern thought primarily in terms of pitches. The two things had to be unified." Boulez had committed himself to formulate a new theoretical system that would serve composers in the future as tonality had served them in the past. He resolved "to strip music of its accumulated dirt and give it the structure it had lacked since the Renaissance."² He made serialism the basis for his new musical language.

Boulez composed his first serial composition in 1946, his Piano Sonata no. 1. Two years later, he completed his Piano Sonata no. 2, a virtuosic tour de force that had a tremendous influence on other young postwar composers. Traditional melody disappeared. There were no themes. Any trace of traditional harmony was eliminated. The piano was used as a percussive instrument; performance directions indicated were "savage," "brutal," and "violent." With the

music anchored in a strict serial system ordering the pitches, Boulez turned to rhythm to create a sense of wild delirium.

With serialism and violent rhythm as his tools, Boulez developed a new language that could be used to crush the life out of romanticism and the music of Schoenberg. Boulez rapidly established a preeminent position among the young avant-garde with his piano sonatas, the vocal work *Le Visage nuptial* based on a passionate text by René Char, and the *Sonatine* for flute and piano. He also sat at the center of a web of important personal alliances.

In 1949, the American composer John Cage visited Paris and became a friend of Boulez. Cage was a student of Schoenberg during his last years in California. While a student of Zen Buddhism in D. T. Suzuki's class at Columbia University, Cage wrote *Sonatas and Interludes for Prepared Piano*. This work used a piano prepared with nails, paper, and other items fixed to the strings to create a variety of percussive sounds and timbres not previously associated with the piano. Both Boulez and Cage used the piano as a new percussive instrument and explored rhythm at the expense of harmony. When Cage returned to the United States later that year he enthusiastically promoted Boulez's music.

Boulez met a young Belgian composer, Henri Pousseur, in 1951. Pousseur showed Boulez a work for three pianos, for which Boulez proposed changes that Pousseur later incorporated. Boulez shared his works with Pousseur and, by Pousseur's account, helped him "to understand that Webern was not an end but a beginning."³

In January 1952, Boulez made a strong impression on a young German, Karlheinz Stockhausen, who had come to Paris to study at the Conservatory. Boulez was also impressed by Stockhausen. Stockhausen showed him his first serial composition, *Kontra-Punkte*; here too Boulez suggested a number of changes that Stockhausen incorporated. Boulez said, "We talked about music all the time—in a way I've never talked about it with anyone else."⁴ When Stockhausen returned to Germany in 1953, he established an avant-garde music movement in Cologne. Stockhausen, Pousseur, and many others followed Boulez in embracing serialism and Webern as the basis for a new music.

Foundations for a New Music

Schoenberg's original theory was for a "method of composing with twelve tones which are related only with one another." Its focus was on the twelve *tones*. Although the notes of Schoenberg's compositions were derived from the series, he used classical forms for compositional structures, and his melodic structures, rhythmic structures, dynamics, phrasing, and orchestration were also traditional. Serialism for Schoenberg was a way of organizing notes.

In Webern's work, however, the postwar composers saw the potential to apply serial techniques to control elements other than pitch (even though Webern himself did not actually do so). Webern's compressed technique had led him to craft every note; often, each note had a different duration, a different dynamic, and a different attack. Though his techniques were directly influenced by the contrapuntal techniques of Renaissance composers, to the postwar composers his music seemed a total break with the forms of the past.⁵

Messiaen was the first actually to apply quasi-serial techniques to much more than just the notes, in particular to the organization of durations, dynamics, and modes of attack. The pitch structures of his compositions, however, were based on modes and other techniques that owed more to the composers of the Renaissance than to Schoenberg.

Messiaen's *Quatuor pour la Fin de Temps* demonstrates the formal dissociation of rhythm and harmony. It was composed in 1940–1941 under somewhat unusual circumstances. Captured by the Germans in 1940, Messiaen was a prisoner of war in a camp in Görlitz, Germany. At the camp there were a clarinetist, a violinist, and a cellist. The clarinetist and the violinist had their instruments; the cellist was given a cello, lacking one string, by the Germans. The work was written for these instruments and piano. A piano, an out-of-tune upright with many malfunctioning keys, was made available by the Germans for the work's first performance, given in the prison camp on January 15, 1941, in front of an audience of 5,000. Messiaen said of the performance, "Never have I been listened to with such attention and understanding."⁶

What is particularly interesting in the *Quatuor* is the formal process Messiaen used to compose the piano part in the first movement. The

piano part, with the cello, creates a sustained rhythmic foundation over which the clarinet and violin perform solo phrases that are derived from birdsong. The piano part consists of two completely independent elements: a progression of 29 chords that is repeated over and over, and a rhythmic pattern of a series of 17 durations that is also repeated over and over. As the lengths of the two progressions are different, the chord progression and harmony are completely dissociated from the rhythmic pattern. The result is a piano accompaniment that seems to drift. The structural relationship between the chord progression and rhythmic pattern is illustrated in figure 6.1. Although it does not use Schoenberg's particular technique of twelve-note serialism, the movement is similarly built on a technique of mathematically rigorous repetition. What is striking is that the formal compositional process was applied to *both tones and durations*.

In 1949, in a work entitled *Mode de valeurs et d'intensité*, Messiaen extended such formal processes to the dynamics (i.e., loudness) of the notes and to their timbre. Again, his technique is effectively the same as applying serial processes. A melodic series of 36 notes repeats over and over, as do a series of 24 durations, a series of seven attacks, and an additional series of dynamics. *For the first time, formal techniques were applied to determine the structuring of all of the key musical elements.*

The 36 notes of the pitch series were organized into three groups of twelve notes, in each of which the twelve pitches occurs once. Following is group 1.

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

Each group of notes was then assigned a series of durations. The duration series for the first group, given a duration of time called *d*, was:

1*d* 2*d* 3*d* 4*d* 5*d* 6*d* 7*d* 8*d* 9*d* 10*d* 11*d* 12*d*

(Thus each duration in the series is longer than the preceding one by the time *d*.)

The second and third duration series are the same except that the starting value of *d* was twice as long for the second series and four times as long for the third series. In total, 24 different durations were

Chords	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Duration	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	1	2	3
Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Chords	21	22	23	24	25	26	27	28	29	1	2	3	4	5	6	7	8	9	10	11
Duration	4	5	6	7	8	9	10	11	12	13	14	15	16	17	1	2	3	4	5	6
Position	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40

Chords	12	13	14	15	16	17	18	19	20	21	22	23	24	25	25	26	27	28	29	1
Duration	7	8	9	10	11	12	13	14	15	16	17	1	2	3	4	5	6	7	8	9
Position	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60

Chords	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Duration	10	11	12	13	14	15	16	17	1	2	3	4	5	6	7	8	9	10	11	12
Position	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

Figure 6.1

Messiaen's chord sequence and duration sequence in the piano part for the first movement of his *Quatuor pour la Fin de Temps*.

organized in the three series. (The first six durations of the second series are found in the first series, and the first six durations of the third series are found in the first and second series.)

There was a series of 7 dynamics, from very very soft to very very loud:

ppp pp p mf f ff fff

Lastly, there was a series of twelve different modes of attack.

Influenced by their teacher, Messiaen, and by the potential they saw in Webern's work, the postwar composers extended the concept of the series and serial manipulation to all of the elements of music.

Serial techniques were used to organize note durations. Different durations were ordered, numbered as members of a series, and then assigned to notes in forward or backward order. Transformations were applied to the durations, lengthening or shortening them. The techniques of serialism were also applied to the dynamics of notes (from *ppp* to *fff*), as these were ordered as members of a series, and to modes of attack.

When Schoenberg died in California in 1951, Boulez wrote an article entitled "Schoenberg Is Dead!" It was an epitaph to Schoenberg in which Webern was crowned as the true creator of a new language.

Boulez's "Structures"

In 1952, Boulez wrote *Structures*, the definitive model of serialism in its most complete application. Boulez planned the work to be like *The Art of Fugue*—Bach's didactic masterpiece on the techniques of counterpoint—for the serial language. Scored for two pianos, the work became a milestone in postwar music.

Boulez used the same pitch series as Messiaen had used in his *Mode de valeurs et d'intensité*, a recognition that he had been strongly influenced by his former teacher. Messiaen's series also gave him an impersonal basis for his composition. "What I was after was the most impersonal material. Personality had to be involved, of course, in bringing the mechanism into action, but then it could disappear after that."⁷

Once Boulez had defined the rules, the "mechanism" could run its own course. The process of composition was effectively automated.

Define the series that control each musical element. Define how these series and controls interact. And then, let the process follow its course.

In *Structures*, Boulez defined a very intricate process. There is perpetual transformation. No pitch ever recurs with the same duration, the same dynamic, or the same attack.

The pitch series is:

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

The duration series, given a duration of time called *d*, is:

1*d* 2*d* 3*d* 4*d* 5*d* 6*d* 7*d* 8*d* 9*d* 10*d* 11*d* 12*d*

Boulez defined twelve very fine gradations of dynamic, from very very soft to very very very loud:

pppp *ppp* *pp* *p* *quasi-p* *mp* *mf* *quasi-f* *f* *ff* *fff* *ffff*

Boulez also defined twelve different modes of attack, representing different ways of performing a note on the piano. These included *legato*, a smooth playing where one note is held until the next one is hit, and various degrees of shortened playing such as *staccato* (where the note is shortened by about $\frac{1}{2}$), *mezzo staccato* (where the note is shortened by about $\frac{1}{4}$), and *staccatissimo* (where the note is shortened by about $\frac{3}{4}$). Other attacks indicated different degrees of accentuation when hitting the note, such as *sforzando* for a very forceful attack and *mezzo forte* for a somewhat forceful attack. Boulez derived orderings for the dynamics and for the modes of attack using tables developed from the series.

Boulez then defined a set of processes that determined the overall structure of the composition, ordering the different series for notes, durations, dynamics, and attacks. He defined the first piano part as the progression of four versions of the note series: the original series followed by the backward, the backward a second time, and then the backward and upside-down. The second piano part's progression is the upside-down series followed by the backward and upside-down, the backward and upside-down a second time, and then the backward. Each note series is assigned one dynamic for the complete series, following a dynamic series. So, in the first piano, the first series is all very very very loud, *ffff*, and the next *mf*. In the second

piano, the first series is somewhat soft, *quasi-p*, the next very very soft, *ppp*. Modes of attack were assigned in the same way; one mode of attack was applied to the first series, another to the second, and so on, in an order determined by the series of the modes of attack. Every pitch, every dynamic, every duration, and every mode of attack for every note is determined by a defined process.

Boulez wrote the following about Messiaen, but it might also have been about himself:

He wants discipline, a discipline that transcends his own personality and refers only to itself, implying its own justification by means of a numerical order that has to be obeyed. He wants as it were to decipher in his own way the secrets of the universe, just as a scientist can transcribe natural laws in numerical terms. In this way a composition strictly observing numerical laws would reflect a transcendent order in which personal desires have no place and are annulled by explicit laws that override any individual purpose.⁸

Stockhausen, Leader of the Avant-Garde

By the time Boulez completed *Structures*, he was convinced that serialism was the only basis for the new music language: serialism as the control of pitch, durations, attacks, dynamics, everything. To Boulez, anyone who did not feel this necessity was missing the point and was a composer without consequence. "Everything he writes will fall short of the imperatives of his time."⁹

Cage, however, had taken another path. He too was looking for ways to take personality out of the composing process, but he was exploring the use of chance, randomness, using the *I Ching* and other techniques influenced by Asian thought. Cage tossed a coin as part of the composition process. Cage wrote a composition, *Imaginary Landscapes*, for twelve radios and 24 performers—one to hold each radio, one to tune it. This composition represented an almost complete loss of control, given that it is impossible to predict what will be broadcast during a performance at some future time and location. Cage wrote 4:33—the duration a pianist sits at the piano without touching the keyboard. In this piece, reflecting Zen influence, the music is the sound of the environment—random and arbitrary sounds—during that particular moment in time. To Boulez, the very thought of chance, of not controlling every element in the greatest

detail, was abhorrent. Boulez broke his relationship with Cage and they had virtually no contact thereafter. (Cage died in 1992.)

More significantly, Stockhausen soon went his own way. In the early 1950s, Boulez and Stockhausen were the leaders of serialism in Europe. After returning to Germany from Paris, Stockhausen worked at the West German Radio (WDR) and began composing electronic compositions. Using sine wave generators, he applied serial techniques to build up the structures of the individual sounds themselves. Serial techniques were also used to organize these sounds into a composition; the composition was unified from the lowest level of the sounds themselves to the highest level of the complete sound structure.

Like Boulez, Stockhausen aimed to dismantle the conventions of rhythm and meter just as they had undone classical tonality. His *Zeitmasse* was composed using a new technique, "discontinuous time." Tempos were controlled by the limits of a player's breath or the player's ability to articulate rapidly. Boulez and Stockhausen had discussed breaking from strict meter, but while Boulez was considering the idea, Stockhausen wrote a ground-breaking work.

Stockhausen then developed the idea of "controlled chance." In *Klavierstück XI*, there are 19 groups of notes, sections of music, each ending with instructions on how to perform the next group—fast, slow, loud, soft. The performer randomly moves from one group to the next following the performance instructions at the end of each sequence, combining chance and control. (Boulez, in the composition *Le Livre* that he based on Mallarmé, also began to explore the random ordering of segments. However, he explained this as a natural evolution of *his* music.)

Stockhausen produced the first major electronic work in the avant-garde world, *Gesang der Jünglinge*. After *Zeitmasse* and *Klavierstück XI*, he then wrote the massive orchestral work *Gruppen*, where three orchestras surround the audience, each playing at different speeds. By 1958, he was established as the innovator and the leader of the postwar composers.

Boulez, on the other hand, wrote few new works and began to pursue conducting instead. Boulez said, "I came to trust Stockhausen's music more than anything else. I felt he could solve all the problems, that it was no longer necessary for me to address myself

to them."¹⁰ The relationship between Boulez and others in avant-garde music circles became more and more strained. Abusive words were exchanged in meetings and in published essays. Boulez gradually withdrew from the leadership of the European avant-garde.

He began to conduct regularly with the BBC Symphony in London, the New York Philharmonic, and the Cleveland Orchestra. In 1977, after eight years as music director of the New York Philharmonic, Boulez became the director of a new music research institute in Paris, IRCAM, the Institute of Research and Coordination in Acoustics and Music, where his task was to lead research aimed at applying technology and computers to open the next frontiers in music. He retired from IRCAM in 1992 to focus again on composing.

Conclusion

Schoenberg thought of his serial method as one for organizing notes. Even Webern, though more important for the postwar serialists, applied serial techniques only to the organization of notes. Messiaen was the first to apply very formal techniques not only to durations but, with *Mode de valeurs et d'intensité*, to dynamics and attacks. Boulez, following the path established by Messiaen, controlled all aspects of the composition in his *Structures* with serial techniques.

The postwar serialist composers created music languages in which every element influencing the content of a musical expression was controlled by explicit and formal rules: pitch, duration, attack, dynamic. To the extent that any attribute was considered important in music, these composers wanted to make explicit the rules governing its organization. They organized the macrostructure of the composition. They organized even the microstructural components of a sound built out of sine waves.

The significance of their vision was in the comprehensive nature of it: formal and explicit rules were used to organize every element at every level of a complex hierarchical system. Their music was totally abstract.

Notes

1 Pāṇini

1. Campbell, *The Masks of God*, p. 155.
2. Basham's *The Wonder That Was India* provides an excellent review of Indian history and culture; it was a key reference for this chapter. Basham's first two chapters were a source for the descriptions of the Indus civilization: my opening paragraph paraphrases his p. 1, and parts of my description of Harappā and Mohenjo-Daro paraphrase his pp. 14–16. Joseph Campbell's *The Masks of God: Oriental Mythology* was another important reference for this chapter. It includes fascinating accounts of the myths and rituals of the ancient Indian and Aryan civilizations.
It should also be noted that alternative views have been proposed of what may have caused the demise of the Indus civilization. In particular, some suggest that it may not have been sudden but gradual, and even that the Aryans may not have been responsible for it.
3. Translation by A. L. Basham in *The Wonder That Was India*, p. 37.
4. Campbell, *The Masks of God*, p. 174.
5. Basham, *The Wonder That Was India*, p. 250.
6. Ibid., p. 241.
7. Tables 1.1 and 1.2 are based on tables found in C. L. Barber's *The Story of Language*, pp. 80–81.
8. This sequence of the generation of *ābhavat* was provided by Dr. Paul Williams, Professor of Asian Studies at the University of Bristol and a scholar of ancient Indian and Tibetan studies. An overview of Pāṇini's grammar and a similar example can also be found in Robins's *A Short History of Linguistics*, p. 161.

2 Circle of Fifths

1. Given that several notes can be indicated either by their "sharp" (♯) or their "flat" (♭) version, the twelve notes could also be seen as:

C, D \flat , D, E \flat , E, F, G \flat , G, A \flat , A, B \flat , and B
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12.

As readers familiar with early Western music may notice, this chapter's discussion assumes the use of the *tempered scale*. This scale represented a slight modification of the earlier pure-overtone-based scale that dated back at least to the Pythagoreans; it involved tuning the scale so that adjacent sharp and flat notes (e.g., C \sharp and D \flat) were identical (in the earlier tuning, a C \sharp was slightly higher in pitch than a D \flat). The use of the tempered scale made possible a vast expansion of the harmonic and melodic vocabularies starting in the eighteenth century, as described later in this chapter.

2. "It seems certain that the Pythagorean acoustic ratios were ratios of lengths and not of frequencies, which the Pythagoreans would hardly be in a position to measure." Copleston, *A History of Philosophy*, p. 33.

3. Grout, *A History of Western Music*, p. 4.

4. Popper, *Unended Quest*, p. 56. Popper's speculations on the emergence of polyphony influenced my discussion here. *Unended Quest* is the autobiographical account of Popper's intellectual development; he discusses his speculations on the emergence of polyphony in Western music in the context of the formation of his ideas on how science progresses. Popper speculates that it was the very rigidity and the fixed nature of melodic chant, codified by the Church, that made possible the invention of counterpoint. The codified chants provided a "dogmatic" environment from which invention sprang; they were the anchors that ultimately permitted distinct voices to sing counter to them. This insight influenced the view Popper developed of how science progresses, namely, that a dogmatic environment provided by a widely accepted scientific view provides the context from which new ideas form, in contrast if not in opposition to the accepted dogma.

5. It should be noted that the rules of counterpoint were actually codified at least 50–100 years after they were widely adopted by convention, by theorists such as Johann Joseph Fux in his 1725 treatise *Gradus ad Parnassum*. Contemporary classic texts include Walter Piston's *Harmony* and *Counterpoint*.

6. The minor scale is characterized by the sequence of intervals
+2, +1, +2, +2, +1, +2.

Beginning with 1, this results in the minor scale:

C, D, E \flat , F, G, A \flat , B \flat
1, 3, 4, 6, 8, 9, 11.

The points made here regarding properties and relationships found in the major scale also apply to the minor scale.

7. It is sometimes suggested that the change could be slipped in almost without the listener noticing that a change of the scale has occurred. However, though widely accepted, this is a misconception of how modulation would have been used—my initial incorrect suggestion to this effect was pointed out by Clive Bennett. Mr. Bennett clarified that the whole point of changing keys would have been to make

a dramatic change that *had to be perceived* in order to be of significance. Piston's text on harmony is explicit about the listener being aware of these changes. "There are three stages in the mental processes of effecting a modulation within a phrase. First, a tonality has to be made clear to the hearer. Second, the composer at some point changes his tonal center. Third, the hearer is made aware of the change, and the new tonal center is made clear to him" (Piston, *Harmony*, p. 78).

An example from Douglas R. Hofstadter's *Gödel, Escher, Bach*, p. 130, demonstrates that this misconception has been shared by others. Discussing the complicated structures and key changes (modulations) in the music of Bach, Hofstadter explains that "it is the magic of Bach that he can write pieces with this kind of structure which have such a natural grace to them that we are not aware of exactly what is happening."

To digress further, in music of a school of Netherlands composers in the sixteenth century "secret chromatic passages" appear. In these passages, notes are not explicitly marked as chromatic and the passages make sense when interpreted without chromatic notes. However, the initiated would interpret the passage with the secret chromatic notes "reserved for those who understood the composer's secret intentions." Donald Grout (*A History of Western Music*, p. 187) explains, "This music is another interesting manifestation of the age-old delight in mystification and concealed meanings in music, as well as a demonstration of the lengths to which composers of this period would go to achieve a striking effect suggested by the emotional content of the text."

8. Piston, *Harmony*, p. 31.

9. Grout, *A History of Western Music*, p. 344.

3 Nāgārjuna

1. Paul Williams has recently "expressed some doubt in print as to whether Nāgārjuna founded Mādhyamaka. He is certainly the first great name in Mādhyamaka." Also, concerning the description of the core tenet of the Mādhyamaka as "the contemplation of *śūnyatā*," he comments: "*prajna* is not the contemplation of *śūnyatā*. Rather, maybe, the nondual absorption focused on *śūnyatā*." (From personal correspondence.) For further discussion, see Williams's *Mahayana Buddhism: The Doctrinal Foundations*.

2. All quotations from the *Mādhyamakakārikā* are from an unpublished translation by Paul Williams, University of Bristol.

3. The source for this argument was Dignaga's opponent, Kumarila Bhatta. However, the presupposition of "A" in a positive sense must not be taken to suggest that "A" has some intrinsic meaning. "A" has no independent internal meaning but is only defined within a system of differentiation. This is consistent with the spirit of Nāgārjuna's interpretation of the Buddha's doctrine of *pratītyasamutpāda*.

4. Quoted in Robins, *A Short History of Linguistics*, p. 149.

5. Culler, *Ferdinand de Saussure*, p. 22.

6. The following example is based on material from Barber's *The Story of Language*, pp. 12 and 17.
7. From Harris's translation of Saussure, *Course in General Linguistics*, p. 9.
8. Ibid., p. x.
9. Of course, the Sanskrit colors substituted are not *exact* substitutes for the English. As discussed later, different languages and cultures divide the spectrum of colors differently. As a result, it is not possible to exactly match the color set of one language with that of another.
10. Culler's translation from *Course in General Linguistics*, in *Ferdinand de Saussure*, p. 36.
11. Ibid., p. 59.
12. This discussion is purely syntactic; that is, it investigates the permissible sequence of words within a sentence. However, as Larry Briskman pointed out, it is not clear that *he frightened the stone* is not *syntactically* acceptable. Rather, it suggests the dependence of syntax on semantics, which in turn depends on theories about the world. (From personal correspondence.)
13. Culler's translation from *Course in General Linguistics*, in *Ferdinand de Saussure*, p. 108.
14. Ibid., p. 105.

4 The Second Viennese School

1. MacDonald, *Schoenberg*, p. 53.
2. Quoted in *ibid.*, p. 22.
3. Quoted in *ibid.*, p. 2.
4. Quoted in *ibid.*, p. 58.
5. Quoted in *ibid.*, p. 8.
6. Quoted in *ibid.*, p. 33.
7. Quoted in *ibid.*, p. 29.
8. Quoted in Griffiths, "Anton Webern," p. 98.

5 Kandinsky

1. From Hahl-Koch, *Arnold Schoenberg, Wassily Kandinsky*, p. 21.
2. From Franz Marc's article "Two Pictures," included in Kandinsky and Marc, *The Blaue Reiter Almanac*, p. 65.
3. From Wassily Kandinsky's article "On the Question of Form," included in Kandinsky and Marc, *The Blaue Reiter Almanac*, pp. 186–187.

4. Quoted in Dube, *The Expressionists*, p. 106.
5. Quoted in *ibid.*, p. 109.
6. Quoted in *ibid.*, p. 110.
7. In Herbert, ed., *Modern Artists on Art*, p. 34.
8. Kandinsky, *Concerning the Spiritual in Art*, p. 9.
9. Ibid., pp. 24–25, 29.
10. Ibid., p. 29.
11. Ibid., p. 36.
12. Ibid., pp. 32–33.
13. Quoted in Lacoste, *Kandinsky*, p. 60.
14. Quoted in Moszynska, *Abstract Art*, p. 74.
15. Kandinsky, *Point and Line to Plane*, pp. 29–32.
16. Ibid., p. 57.
17. Ibid., p. 93.
18. Quoted in Lacoste, *Kandinsky*, p. 77.
19. This and the following passage are from Hahl-Koch, *Arnold Schoenberg, Wassily Kandinsky*, p. 81.
20. Kandinsky, *Point and Line to Plane*, p. 92.
21. Ibid., p. 83.

6 Postwar Serialism

1. Quoted in Peyser, *Boulez*, p. 25.
2. Ibid., pp. 44, 25.
3. Ibid., p. 74.
4. Ibid., p. 76.
5. Regarding Webern's application of serial techniques beyond pitch, see the discussion in Perle, "Anton Webern," pp. 112, 123.
6. Johnson, *Messiaen*, p. 61.
7. Quoted in Peyser, *Boulez*, p. 67.
8. Boulez, *Orientations*, p. 415.
9. Quoted in Peyser, *Boulez*, p. 70.
10. Ibid., p. 132.

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