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PART I THEORY

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CHAPTER 1 STRING INSTRUMENTS

General information

For the following reasons, we will first consider the string instruments as a uniform group and then examine them separately according to a fixed system of criteria within each theme discussed.

The commonalities and similarities in the construction and playing technique of the string instruments greatly outweigh their differences. String instruments are a very homogeneous instrument group and do not have the striking differences between them that the wind instruments do. Examining four different string instruments according to different topics (range, characteristics of the strings, multiple stops, harmonics, etc.) gives us the advantage of being able to compare the instruments with one another directly and makes flipping the pages back and forth unnecessary.

Characteristics

Bowed string instruments have certain characteristics which separate them from other instrument groups:

- Because of the acoustic homogeneity of the string instruments, their combined range of seven octaves provides a uniform timbre with only minimal individual differences.
- The differences of timbre between the registers of a single instrument are almost negligible.
- The entire dynamic palette can be required of any string instrument in any range.
- Many different methods of sound production are possible, including sustained or quick passages, smooth or active lines, scales, arpeggio or leaps, tone repetitions, trills, tremolo, multiple stops, pizzicato, col legno and many more.
- String instruments are rich in overtones and for this reason can be used in close or wide spacing.
- They can be used for longer periods of time without becoming tiring for the listener or the player.

Instruments and their parts, bows and strings


The members of the string instrument family in the modern orchestra are the violin, the viola, the cello and the double bass. Only the double bass is a transposing instrument, sounding one octave lower than written. In general, these instruments have the same basic structure (except for the double bass, which has more to do with the viol family and is, like them, tuned in 4ths). The main difference between them lies in their sizes, their ranges and their timbres (which correspond in a certain way to their sizes). Violin, viola and cello have more or less the same form with rounded shoulders. The shoulders of the double bass are angled more steeply.

As the production of various pitches depends on coordination between bow and strings, we will talk about these first. A string bow consists of two parts: the wooden rod (of pernambuco wood) and the horsehair strung along the rod. The bow is held on the so-called frog, a movable part of the bow with a screw mechanism, which is used to regulate the tension of the horsehair.

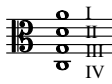
String instruments

The other end of the bow is called the point (tip). For practical reasons, the bow is divided into three portions: the upper, middle and lower thirds. These are important for various bowing techniques (see details below in the section “Bowing” on page 9). The strings are attached to turnable pegs held in the peg box, which is located between the scroll and the neck of the instrument. The raised part between the peg box and fingerboard is called the nut. The fingerboard, made of ebony, is secured to the neck. The strings are strung along the fingerboard where they can be gripped by the fingers of the left hand and their pitches changed. The lower half of the fingerboard extends across the body of the instrument without touching it. The strings continue over the bridge, which not only holds them but also transfers their vibrations to the body. Finally, the strings are tied to the tailpiece, which contains fine tuning screws and is in turn attached to the body of the instrument. The strings are tuned as follows:

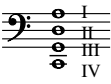
Violin



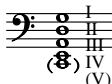
Viola



Cello



Double Bass



Some double basses have a fifth, low C-string. Some four-string double basses have a special attachment (C-attachment), which can lengthen the E-string, allowing tones down to contra-C.

The strings of the violin are the thinnest and lightest. They also respond well to gentle bowing. The strings of the viola, cello and double bass become progressively thicker and heavier and respond less and less easily, especially in light, quick and delicate passages. This is especially true for the double bass; the differences in timbre produced by the various bowing techniques are also more prominent on the double bass. Thus the violin is the most agile of the string instruments; the cello, the most agile bass instrument of the orchestra. If the double bass is required to play a very agile bass line together with the cello, it is usually given a simplified version of the cello part.

On any one of these instruments, the higher strings respond more easily and sound brighter but resonate less strongly than the lower strings. For this reason, quick staccato passages sound faster and more brilliant on the violin, but are not as clearly articulated, while similar passages on the cello or double bass are accompanied by more noise components but are articulated more clearly. Larger instruments respond more slowly, are darker in tone and have more resonance.

The acoustic properties of the strings of the string instruments are of extreme importance for instrumentation and should be studied carefully to ensure the correct choices in scoring:

Violin

E-string: brilliant, powerful; transparent and luminous in *piano*
A-string: fairly brilliant and powerful in its low range. Much of this brilliance vanishes in the higher range, making the A-string suitable for passages in the two-line octave range in which the brilliance of the E-string is not desired.

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D-string: the least powerful string, with a warm, mellow colour which becomes even warmer in the higher range; ideal for lyrical passages

G-string: powerful, sonorous; intensive and penetrating in its higher range

Viola

A-string: fairly penetrating, though not as much so as the E-string of the violin; has a nasal quality; good for solo passages

D-string: fairly weak and uncharacteristic; mostly used for accompaniment figures

G-string: also fairly weak, not as powerful as the G-string of the violin; also used for accompaniment

C-string: typically powerful, dark, raw and hard

Cello

A-string: the most penetrating string with the most brilliance; typical for solo passages

D-string: warm and gentle; very good for lyrical lines

G-string: comparatively the weakest string, but still powerful

C-string: has true bass qualities; rich and sonorous

Double bass

G-string: fairly mellow, good for soli and harmonics

D-string: the most used string, with a typical bass sound; more solid than the G-string but more mellow than the A-string

A-string: a quite powerful bass sound, good for the orchestra

E-string: fairly thick, heavy and dark; rather unclear in quick passages

C-string: very thick and heavy, very dark; not suited for quick passages

One observation concerning the double bass is of utmost importance for the novice orchestrator and must be made at the very beginning. The sound of the double bass is relatively small, weak and distant – which does not mean, however, that it cannot play loudly. For this reason, the double-bass line must be doubled by at least one other instrument or group of instruments, preferably (but not necessarily) in the upper octave. The most satisfying results will be achieved in this way, as double basses have a wonderful quality of lending depth and acoustic richness to a bass line played by other instruments. Many composers who have attempted to use the double bass as a single bass instrument have had to revise their works and reinforce the bass lines with other instruments; Bruckner was one of them. On the other hand, not every bass line needs to be doubled with double basses, not even in loud passages in a large ensemble. Bass trombone and tuba can be used to play a very effective bass line that would become less penetrating if double basses were to be added. In special cases, for example in soft passages and in a reduced ensemble, the double bass can be used now and then without being doubled. (As pizzicato produces very good results on the double bass, a pizzicato line on the double bass can function without being doubled, if the dynamic is not too loud.)

Before we get to our next theme – the ranges of the instruments – here are a few additional observations concerning points which may affect timbre on the string instruments:

- The smaller the point on the string which is activated (as, for example, by fingernail pizzicato), the more overtones are produced, resulting in a nasal, guitar-like sound. The larger this point of contact (through the hair of the bow or the fingertip being used for pizzicato), the darker the tone becomes.

String instruments

- The tone quality and dynamic depend directly upon the pressure and speed of the bow. When the bow pressure is increased, the bow speed is reduced. Of course the speed of the bow depends also upon the tempo of the piece played.

Ranges

The usual ranges of the string instruments are:

Violin



Viola



Cello



Double Bass



(sounds one octave lower)

In contemporary music it is difficult to determine the upper limits of the ranges. Many composers tend to require more tones in the upper ranges than are notated above (for example, a notated c''' or even db''' for the double bass!). Some require “the highest possible tone.” In this case, the finger is placed so high on the string that only enough space remains to set the bow between the finger and the bridge. This is notated as follows:

VI.



Sometimes the lowest possible tone is requested. This doesn’t make much sense with the strings, as their lowest possible tone is always that of the lowest open string. “Lowest possible tones” are, however, used in notation for the brass, as the ranges of these instruments can be expanded downward in certain cases through use of unorthodox fingerings, blowing techniques or mouthpiece effects. With string instruments, it is of course possible to extend their range downward by tuning the lowest string lower than usual. The lowest string on the violin and viola can be tuned as much as a major 2nd (or even minor 3rd) lower; in certain works for the cello, the string is lowered by a perfect 4th. This technique is called “scordatura” (see page 60).

Clefs

The clefs used for notating the string instruments are:

- violin: treble clef
- viola: alto and treble clef
- cello: bass, tenor and treble clef. (In older scores, in which no tenor clef was used, the treble clef was used but read an octave lower. This technique is no longer used.)
- double bass: bass, tenor and treble clef (each sounds an octave lower than notated)

Changing clefs is recommended if three or more ledger lines become necessary. For individual high or low notes which can still be notated in the currently used clef, no change is necessary.

Methods of sound production

The violin and viola are laid on the left shoulder and held with the chin. The thumb of the left hand supports the neck of the instrument lightly. The other four fingers of the left hand lie on the fingerboard and grip the pitches on the strings (or execute other motions such as pizzicato or glissando, which we shall discuss later).

The cello is held between the knees of the seated player and stands on an adjustable peg. The neck extends over the player's left shoulder. The double bass also stands on an adjustable peg, and the player stands or sits on the right side behind the instrument, which is additionally supported by the player's left knee.

With all these instruments, the right hand holds the bow, which is normally stroked on the strings between the fingerboard's lower end and the bridge. This technique is called **arco** or **col arco**. The point of contact between bow and string can be varied drastically depending on the required sound, as we will see later. When laid on the strings, the bow forms a right angle with the fingerboard. An open string rings in its entire length between bridge and nut. In some special techniques (for example, pizzicato), sound is produced without use of the bow. During shorter pizzicato passages, the player holds the bow in the right hand and uses the fingers to produce sound by plucking the strings. During longer passages (often entire formal sections), the bow is laid away on the side.

The fingers of the left hand determine the pitch (except notes on open strings) by pressing different points on the strings against the fingerboard and thus shortening them. The left hand has a certain position on the fingerboard which it changes by sliding up and down along the same in order to produce various pitches. These positions are numbered: first, second, third position, and so on.

Fingering (stopping) techniques and positions

For the novice orchestrator who is not a string player, it will be enough to learn just the basic principles of fingering technique. The following will explain the system of "positions," but do not attach too much importance to this. Detailed knowledge and understanding of the positions does not really have much to do with instrumentation. **The fingerboard is a unit in and of itself and does not "contain" or "consist of" different positions.** These are only visualisations, developed as a system for teaching string technique and also for facilitating communication between string players on subjects of technique and interpretation.

The following symbols are used for fingering instructions: "0" open string; "1" index finger; "2" middle finger; "3" ring finger; "4" little finger. "0" for open string should not be confused with the "°" for harmonic.

When the first finger is placed for the first note on any string, this is called "first position." When the first finger is placed for the fourth note on the string, this is "fourth position." For example, when the first finger plays the note a on the G-string, we are in first position. The other three fingers are in position for the next three notes (b, c', d') and their chromatic alterations. If the first finger plays d' on the A-string on the viola, we are in third position and the other fingers are ready to play the next three notes (e', f' and g' with alterations). This explanation is intended as an initial orientation for those who are not familiar with string instruments. We are dealing with a very flexible system with many exceptions. For example, when the first finger plays eb' instead of e' on the D-string, this is called "half position." Similarly, there are other so-called "half positions," especially on cello and double bass, which can be described as slightly higher or lower "altered" positions between the "regular" ones. They are of little importance

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for practical instrumentation and will not be discussed here in detail. However, the following information is useful for instrumentation.

Most pitches can be played on various strings, resulting in different timbres. For example, *g''* can be played on all four strings of the violin. On the E-string it sounds clear and strong; on the A-string, much more mellow, almost muted; on the D-string, rather dark and nasal; on the G-string, very scratchy and distorted. (A higher tone sounds less brilliant than a lower tone on any string for the following reason: as the pitch becomes higher, a progressively shorter portion of the string actually rings.)

In most cases the players will decide which note or passage is played on which string. However, the composer or arranger may have special colours in mind for certain passages and may require a certain string; this should be noted in the score. Instructions for requiring a passage to be played on a certain string should be given as follows:

- English: on the D-string *or* III
- German: auf der D-Saite *or* III
- Italian: sulla Re corda *or* sulla IIIa (3a) C. (corda)
- French: sur la III (3e) corde *or* sur (le) D (Ré)

Positions higher than the fifth are seldom used on the low strings but rather often on the first (highest) one. As the left hand moves into higher positions, the distance between the notes on the fingerboard becomes smaller, which brings certain advantages (for example, easier fingering of larger intervals, which would be impossible in lower positions; heightened intensity and expressivity on some strings such as the G-string of the violin, etc.) but also certain disadvantages: heightened difficulty in intonation control; diminished intensity on some strings such as the A-string on the violin; loss of brilliance; and progressive difficulty fingering pitches, especially multiple stops. The latter instance is not only because the distance between the strings increases, but also because the distance between the strings and the fingerboard becomes greater. Loss of brilliance can sometimes be a desired effect.

All this is true for the other string instruments as well. Due to the size of the viola, the distance is greater between the fingers playing neighboring notes. For this reason, chromatic notes are more easily played on the viola.

In the case of the cello and the double bass, the size of the instrument and the resulting increased distances between the tones on the fingerboard result in changes in fingering technique. In the lower ranges of the cello, the index finger and little finger together can span a major 3rd (on the violin, they can span a tritone; on the viola, a perfect 4th).

Because the cellist does not need to hold his instrument, he can use the thumb of his left hand (in addition to the other fingers) to finger notes. The thumb becomes very important as of the seventh position, especially used to finger large intervals such as octaves on neighboring strings. The symbol for fingering with the thumb is φ :

Vc. 

On the double bass, the ring finger is always used together with the little finger; this means only three “fingers” can be used: the index finger, the middle finger, and the ring and little fingers together. From seventh position onwards, the thumb can also be used and the middle finger can also assume a role independent of the ring finger. The thumb is used for fingering pitches and also as a kind of saddle to stabilize the left hand on the fingerboard.

Sharp keys are better suited for the string instruments than flat keys.

Leaps

Large leaps can be very effective on string instruments in solo passages and repertoire but in orchestral music they are somewhat risky. The following leaps are especially difficult for strings in the orchestra:

- legato leaps
- large leaps on one string
- leaps across one or two strings

Bowing

General information

The bow will be drawn across the string of a string instrument either as a down-bow \sqcap or as an up-bow \vee . The choice between the two bowing types depends on many factors which we will discuss later. To begin with, let us say that a rising line usually requires a down-bow and a falling line is usually played with an up-bow. The symbols \sqcap and \vee , if absolutely necessary, are notated above the pitches. Though there are many systems of classification for bowing techniques, we will begin with the most basic.

Non-legato (separate bows)

If no slur is marked, the direction of the bow changes with each note:

Allegro

VI. I



Johann Sebastian Bach: Brandenburg Concerto No. 3 in G major, 1st movement

Legato (slurred bowing)

When two or more notes are notated under a slur, they are played in one direction without a change in bow direction. Legato is possible on one string or between neighboring strings. It is impossible to skip over a string in legato (for example, from the G-string to the A-string).

Adagio

Violino piccolo (sound)



Johann Sebastian Bach: Brandenburg Concerto No. 1 in F major, 2nd movement

The number of notes that can be played under one slur is limited. The possible length of a slur depends upon various factors.

Aesthetic factors

- style of the music
- character of the music

String instruments

Technical factors

- Tempo: The faster the tempo, the longer the slurs can be.
- Dynamic: The softer the dynamic, the longer the slur can be.
- Type of bow: In relationship to the requirements of the instrument, the violin bow can be considered longer, in a certain sense, than that of the viola, cello or double bass. Thus longer slurs can be required of the violins.
- Type of bowing: See page 12.

The maximum lengths of slurs on the violin can be approximated through use of the following list (the duration will be respectively shorter on the viola, cello and double bass):

- 12 seconds in *pp*
- 6 seconds in *p*
- 3 seconds in *mf*
- 1 second in *f*
- 0.5 second in *ff*

When we consider that a quarter note lasts for one second at a metronome marking of 60, the rest is easy to calculate. Three quarter notes at MM = 60 (per quarter note) last three seconds. In *p*, this requires one half of the bow; in *mf*, the entire bow. Similarly, two eighth notes at MM = 120 (per eighth note) last one second; they are equivalent to a quarter note at MM = 60. In this case, the entire bow will be used in *f*, but only a sixth of the bow will be used in *p*.

Caution: The number of notes under one slur is not necessarily a reliable indication of the actual duration of the stroke. One can be easily misled:

Allegro molto appassionato

Violino principale



Allegro molto appassionato

VI. I



Mendelssohn Bartholdy: Concerto for Violin and Orchestra, Op. 64 in E minor, 1st movement

The slur of the “violino principale” in this example looks twice as long as the slur of the “violino I”, although actually they are the same length. Still, the solo violin does have a solo function to carry out here and, despite having the same dynamic marking as the first violins, needs to be heard more. (In practice, this is known as the brilliancy factor.) As a consequence, the solo violin will use more bow.

When writing legato, one has to be careful that alternating down- and up-bows maintain parity among themselves, especially if they are not separated by rests. Repeated long down-bows and short up-bows (or vice versa) will upset this balance and cause difficulties, if not impossibilities, in execution. The length of the bowings should be kept as symmetrical as possible. If an even