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VIOLIN INTONATION

LAHTI UNIVERSITY OF APPLIED SCIENCES
Degree programme in Music
Music performance
Thesis
Spring 2012
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Degree programme in Music

MARCHUK, OLEG : Violin intonation.

Thesis in music orientatione, 43 pages.

Spring 2012

ABSTRACT

The work of the violin tone. Intonation is not only a fundamental component of music but also one of the most difficult issues, especially for violinists. This is due to differences in the methods of teaching and different approaches to intonation. There is mainly a difference in the harmonic intonation, when a performer strives to accurately reflect the even-tempered tuning of the piano, and acoustic intonation based on overtones and psychophysiological perception of the "purity" and "correct" intonation.

This "Thesis" is composed of five main parts. The first part describes how people respond to musical sounds, reveals physiological characteristics of human perception of music in general and intonation in particular. The second part is historical, it contains information about how people analyze music how movement of theoretical ideas has developed in the field of intonation for a long time and until the time of Johann Bach. The third part presents the views of the famous teachers and artists from different countries. Their sometimes conflicting views can shed more light on the question of violin intonation and identify the basic laws and regulations. In the fourth part of the research the techniques and features are discussed in detail, practical advice is given necessary to every violinist for the practical exercises. The fifth part is the conclusion: the analysis of research results and knowledge gained.

With the help of this research, I have learned how difficult the process of violin intonation and work on the intonation is, how important the intonation in music is in general, for violin, and the other musicians not bound by the mathematically correct even-tempered scale. This study also showed that it is impossible to bring a musical tone to the strict laws and rules in following which one will acquire perfect intonation. In order to succeed knowledge of the theory and all rules alone are not enough. It is necessary to create music and realize oneself in it, based on these rules and knowledge.
The material for this work comes from teaching literature and personal experience and practice.

Keywords: Violin tone, intonation, learning to play the violin, peculiarities of the violin tune.

Lahden ammattikorkeakoulu
Musiikin koulutusohjelma

MARCHUK, OLEG: Viulun intonaatio.

Instrumenttiopetuksen opinnäytetyö, 43 sivua.

Kevät 2012

TIIVISTELMÄ

Tämän opinnäytetyön aiheena on viulun äänensävy eli intonaatio. Intonaatio on musiikin perustavanlaatuinen komponentti sekä yksi vaikeimmista kysymyksistä erityisesti viulisteja varten. Se johtuu opetusmenetelmien välisistä eroista ja intonoinnin erilaisista käsityksistä. Intonointi jaetaan kahdeksi päälajiksi: toinen on harmoninen intonointi, kun esittäjä pyrkii mahdollisimman tarkkaan huolehtimaan esim. flyygelin tasavirityksestä ja toinen intonointi on ns. akustinen, joka perustuu sekä yläsäveliin että ”puhtaan” ja ”oikean” intonoinnin psykofysiologiseen ääniaistimukseen.

Tämä "Thesis" koostuu viidestä pääosasta. Ensimmäinen osio kuvaa kuinka ihmiset reagoivat säveliin ja aistivat musiikkia ja intonaatioita. Osiossa keskitytään myös ihmisen psykofysiologisista ominaisuuksiin musiikin saralla. Toinen osio on historiallinen. Se kertoo miten ihmiset analysoivat ja käsittävät musiikkia, ja miten he kehittävät sen teoreettista pohjaa intonoinnin alalla muinaisajasta alkaen aina Johann Sebastian Bachin aikaan saakka. Kolmas osio esittää eri maiden tunnettujen musiikinopettajien ja muusikoiden katsomuksia. Heidän enimmäkseen ristikkäiset mielipiteet auttavat syvemmin ymmärtämään viulun intonaation sääntöjä ja lakia. Neljännessä osiossa käsitellään yksityiskohtaisesti teknisiä keinoja ja erikoisuuksia ja annetaan jokaiselle viulunsoittajalle hyödyllisiä ja käytännöllisiä neuvoja. Viides osio koostuu yhteenvedoista, tutkimuksen tuloksien analyysistä ja saaduista tiedoista.

Tämän tutkimuksen avulla sain tietää kuinka vaikea on viulun intonoinnin prosessi ja sen omaksuminen. Intonaatio on erittäin tärkeä musiikin elementti viulisteja ja muita muusikoita varten, jotka eivät toimi oikean matemaattisen tasavirityksen puitteissa. Tämän tutkimuksen tulokset myös osoittavat, että musiikin intonaatiota on mahdotonta alistaa tietyille laille ja tarkoille säännöille, joiden noudattaminen tuo ihanteellista intonointia. Savuttaakseen menestystä pelkän teorian ja sääntöjen tuntemus ei ole riittävää, vaan pitää luoda musiikkia ja realisoida itseään siinä näiden sääntöjen ja tietojen nojalla.
Aineisto tätä opinnäytetyötä varten oli saatu oppi- ja tietokirjallisuudesta, henkilökohtaisesta kokemuksesta ja harjoittelusta.

Avainsanat: Viulun äänensävy, intonaatio, viulunsoiton opetus, viulun viritysjärjestelmä.

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1 INTRODUCTION

This work is devoted to the violin intonation. Very often, in my practical work, I have heard comments concerning the intonation, such as: "play cleaner," "play in the key," "here you have to play a little lower (due to the nature of harmony)", "play a little higher here." The violin art is largely based on feelings and perceptions. On the other hand I have always wanted to know precise figures, to know how much it is "slightly higher" or "below" to play each note in order to achieve optimum intonation. Generally, what kind of unit can measure it - millimeters, percent, hertz?

In this thesis I have tried to combine the highly controversial nature of things. We can say that this work consists of a collision of interests, opposing views, combining the world of science and the world of art. We begin with the basics, such as what sound is and how we react to it. After that we head into the history in general, the history of intonation thinking, attempts to express the rules, theories and formulas, what we hear and feel. Followed by a comparison of mathematical figures and case studies, scientific formulas and perceptions of performers and listeners, it seems that each theory contradicts the previous one, in a way, and at the same time confirms the general rules of intonation. I ask myself if it is possible to find a single answer, the very formula, or the feeling at all that will make the process of intonation perfect and conscious. In this thesis I will try to examine these issues, analyze all the information step by step.

The final target of this thesis is to find answers to many questions related to the violin intonation and, consequently, to use this knowledge to improve it.

2 IMPLEMENTATION

2.1 Introduction

The mechanism of intonation is complex and intonation at the same time simple. If considered as a whole, to intone purely on the violin, you must have developed a musical ear, the activity of hearing, hearing with the coordination of movements, the correct motor skills. Only the combination of all these parties ensures perfect artistic intonation. Consider some of the bottom of the details.

2.2 Music ear

The major component of intonation is musical ear and sense of violin sound. It is the characteristics of human auditory perception that musical art is based on. In capacity of information obtained the ear is far more superior than vision, giving a rich picture of the world around us. Changes in the volume, height, sound interruptions, duration and location of sounds in space gives a maximum speed of receiving and processing by man equal to 7.2 bits per second, whereas vision processes only 4.4 bits per second, and this is without taking into account the tone. Musical sound carries with it a greater amount of information. (Grigoryev 2006, 23.)

In broad terms, an ear for music - this is a specific mode of perception and analysis of individual elements of music. There are the outer and inner ear for music, which are closely interrelated and represent two distinct processes:

- The perception of the music world.

- Creation of subjective perceptions based on the work of memory and imagination.

Music sound is different from the normal sounds surrounding man for its special qualities, arising from the long centuries of musical history. It is the basis of the language of music, a building material to create an artistic image, the meaning of the works. One has to understand that the musical sound is not just the domain of physiology or acoustics but also in psychology and aesthetics.

Musical sound is part of a special artistic system where the interrelations between sounds are more meaningful than sounds themselves. Such links horizontally in time form a tonality, while connections in the vertical space of several sounds form a harmony. These are the main coordinates of the music, which determine its nature and particular features of musical thinking.

The human ear picks up sound waves, and our consciousness gives them a subjective coloring, treats, depending on the objective qualities of sound. The objective qualities of the violin sound are the oscillation frequency (pitch), duration (rhythm), amplitude (dynamics), their various forms, the presence of harmonics and other characteristics of the spectrum (timbre), as well as noise and the characteristic overtones (creak, overtones metal, rosin, wood, etc.). Besides the importance of sound in the structure of the work, its artistic system is essential.

2.3 Development of hearing

In the mind of the performer and the listener, all these elements combine to lead to the birth of the individual inner sense of sound which compares with the real, external sense and is corrected. This is the degree of development of the inner ear, the ability to create vivid musical images and compare them with the actual, audible external sounds that is the most important indicator of the professionalism of a musical ear. (Grigoryev 1993, 80.)

The general properties of the hearing providing a dynamic perception of sound are:

- Uneven perceptions of the dynamics in the frequency range most sensitive hearing falls on its middle part and falls off sharply toward the edges.

- Nonlinearity of perception of the change in the volume, one need to increase the volume fourfold to feel the change in 2 times.

- The effect of acoustic saturation. The same sounds or phrases repeated with the same volume are seen with decreasing dynamics.

- Intensification of hearing caused by bright contrast. After a loud noise sensitivity of the ear increases, then decreases and increases again.

2.4 Auditory Illusions

An important factor which is not always taken into account by a performer is the auditory illusion. The phenomenon which occurs with a very precise production of double notes. G. Tartini noticed that the very precise "tuning" while playing double notes contain a third tone - the sound of bass and double notes begin to sound like a chord. This saturates sound greatly and provides additional expressiveness not written by the author and not contradictory to the musical idea. This third tone is not acoustically objective, it is a subjective perception of the emerging human hearing system. The effect arises due to the addition of vibrations of two groups of auditory fibers, and due to resonance the excitation of fibers of a lower frequency that is perceived as a real sound by the performer and the audience. The same effect arises from multiple pulse ratio of two different sounds, in this case, the ripple peaks, coinciding at regular intervals, create an effect "waves" in the ear which can be seen in trills and tremolos, as well as strengthening the dynamics of sound in vibrato when there are clearly distinguishable ear "beating" of sounds close in frequency. (Grigoryev 2006, 26.)

2.5 Color hearing

Another side of playing the violin is psychophysiological called "color hearing." The phenomenon of color hearing is well-known, many composers such as Mozart, Rimsky-Korsakov, Scriabin and others had it. There is some correspondence of tonalities to feelings of "light" and "dark", "joyful" and "deplorable" conditions. For example one of the darkest tones to create a tragic state is considered to be "h-moll", Mass by Bach, sonatas by Chopin, Liszt, and many other composers were written in this tone. The color also depends on the range, lower case is usually dark, and high is light. For violin string "e" shining light colors are preferred, and for bass, thick, very dark colors are preferred. It is interesting that in the absence of vibrato sound loses its color, it usually occurs at very precise, "dry" tuning of a piano or a narrow band unison of orchestra. (Grigoryev 2006, 27.)

I. Newton introduced a relevance of interval ratio and color of the series in order of decreasing sound intervals performed together:

Minor seventh	Red
Major sixth	Orange
Fifth	Yellow
Fourth	Green
Minor third	Blue
Tonic	Blue
Octave	Purple

Table 1. A relevance of interval ratio and color by I. Newton.

There is a connection between the characteristic timbre and emotional state of man, his mood. Clear sound or a bright vibrato is associated with elevated mood, excitement, quiet sound is associated with appeasement, and the muffled sound with virtually no vibrato hints at meditation or concealment.

The last thing to take into account is the national peculiarities of hearing, speaking, pronunciation, and even voice timbre, all impact on artistic thinking, making each person unique and unrepeatable, which ultimately affects the subjective perception of intonation.

3 THE HISTORICAL PART

3.1 Origin

The problem of purity and accuracy of intonation has always generated interest in musicians. Even in ancient Greece, in the IV century BC, there was a dispute between Aristoxenus, a pupil of Aristotle and his followers with the Pythagoreans that the quarto-quint system modes according to Aristoxenus is of no practical value and should be replaced by the division of temperaments quart tetrachords in 5 equal semitones.

History at the time decided the dispute in favor of the Pythagoreans, establishing the principle of four-high-order modes as a fifth in the practice of performance and music theory throughout the development of monody in Europe.

The Aristoxenus school was not the only one to argue against the Pythagorean system of intonation. In the last two centuries BC, there was one opinion raised against the principle of Pythagorean intonation harmonies - the principle of introducing possible maximum of the simplest acoustic relations. The most prominent representative of this trend was Didymus in the I century BC, who established that tierce-quint system mode, which subsequently, during the development of polyphony in Europe, has attracted the attention of theorists to this day, although in practice it was superseded by the equal temperament theoretically preferred by many as a basis for polyphonic tones. (Lesman 1964, 235-237.)

3.2 Development of the theory of musical intonation in Europe

Originally arose purely acoustic attitude to harmony as a consonance or dissonance, was variously estimated by musicians in the development of polyphony. Some of them, prone to creative and performing practice, found a factor in natural thirds and sixths separating the unity of tone and requiring overcoming. Others engaged in the theoretical development of musical problems saw a key to the knowledge of the secrets of harmony in the unstressed, quiet acoustic sound of thirds and sixths. This was the beginning of a century-old and discrepancy between theory and practice in the field of musical melodic intonation, which is yet to be resolved.

This century-old struggle between the theoretical and creative attitude toward the intonation harmony filled Western European history with an understanding of harmony around the XV century. One of the first theorists of the acoustic approach to harmony was Ludovico Fogliani in late XV - early XVI century. Through experiments on the monochord, he proved that the half-tone "e" - "f" is not a lymm-value less than half of the pitch, as previously thought, but a large semitone. It was practically the revival of Didymus's system, who asserted that musical tone consists of a natural third.

The move towards an acoustic interpretation of the values of harmony was further developed by Gioseffo Zarlino in the XVI century, proving that the major third is 13.7 cents (cent = 1 / 100 tempered semitone) of tempered thirds, and 21.6 cents of thirds of the Pythagorean system. Historical work of Zarlino was sharply criticized by the famous lute player Vincenzo Galilei, who argued that the modern diatonic is mostly Pythagorean and that semitone, to be precise, should be not 9.8 cents already tempered, but 11.7 cents wider than the tempered semitone. It will be important in the times of the development of polyphony and harmony.

Artists who sought the secret of setting keyboard instruments realized that tierce, quint system with its different values of major seconds and different forms of major tetrachords requires, when modulating from one tone to another, strong shift of similar sounds by Didymus' comma or Syntonic comma and, therefore,

needs some changes to use this harmony for keyboards. The presence in the tierce, quint structure of a harsh false (narrowing) fifth and false triads on the second scale tone of major harmony necessitated the removal of this serious deficiency.

The task of adaptation of tierce-quint system to the mechanism of keyboard instruments was solved, as successfully as it was possible at that time, by Arnold Schlick in the XVI century. He distributed the Didymus' comma separating the natural from the Pythagorean major third between the components of the last four fifths by cutting each fifth by 5.375 per cent. Schlick reasoned that a major third, formed by four fifths, is larger than natural by a Didymus' comma for the elimination of which it is necessary to reduce each of the four neighboring fifths by a quarter of this comma. In this structure all the fifths and fourths, except for "cis" - "gis" and "as" - "es", sounded not quite clear, but acceptable, and intonation in keys without "gis" and "as" was pretty good for tierce-quint system. The keys, which included "gis" or "as" transformed in the present system into a sound of medium pitch sounded totally unacceptable, because of a very high fifth of 717 cents instead of 702 and a very small fourth of 483 cents instead of 498. Thus, the method of Schlick's temperament, albeit having its merits, by which it dominated until equal temperament, was still very imperfect, limiting the creativity of musicians.

How can we explain the failure of Schlick, and many others who tried to improve the tierce, quint system? This can be explained by the fact that they did not understand the causes of failures in tierce, quint scale. Natural thirds do not improve the system of harmony, but degrade it, to achieve harmony of polyphonic tones on keyboards one should not draw a fifth to third, but thirds to fifths.

The first to understand it at the beginning of XVIII century was Werckmeister who decided to distribute between fifths not the Didymus' comma for at least several acoustically pure thirds, but the Pythagorean comma, which also made possible the preservation of quarto-quint system for the organ and harpsichord. The idea of Werckmeister was supported by Neidgardt, who started distributing the Pythagorean comma among the eight fifths of organ and harpsichord tune, rather than four fifths, which Werckmeister had developed. It was Johann

Sebastian Bach who brought the idea of Werckmeister to its full development by spreading the Pythagorean comma among all twelve fifths of a twelve-sound keyboard pitch. At the time, even-tempered scale was seen as a necessary improvement of the natural tierce, quint system, and the theory of multi-voiced intoning was based on this natural pitch.

Thus we have traced the movement of theory in the field of intonation in the light of the doctrines of harmony until the Bach era. Let me explain some of them in detail. (Lesman 1964, 238-245.)

3.3 The Pythagorean tuning

The Pythagorean tuning, formulated in accordance with the mathematical calculations of interval values that are characteristic of the Pythagorean school of harmonics, a way of building relationships between the sounds of a certain pitch. It was attributed to Pythagoras from the time of late antiquity. The abstract mathematical representation of the Pythagorean structure formed in the era of Western European Baroque. Usually represented as a sequence of fifths or fourths, for example, here is the chain of six fifths of the sound "f":

F - C - G - D - A - E - H

Or in the form of the diatonic scale:

C	Whole tone	D	Whole tone	E	limma	F	Whole tone	G	Whole tone	A	Whole tone	H	limma	C
	203,91 cent		203,91 cent		90,22 cent		203,91 cent		203,91 cent		203,91 cent		90,22 cent	

Table 2. The Pythagorean diatonic scale.

The following table shows the intervals of Pythagorean tuning, not exceeding an octave, and received by not more than 18-quint steps. (Lesman 1964, 248.)

Abbreviations: "min." - minor, "maj". - major, "dim." - diminished, "aug." - augmented.

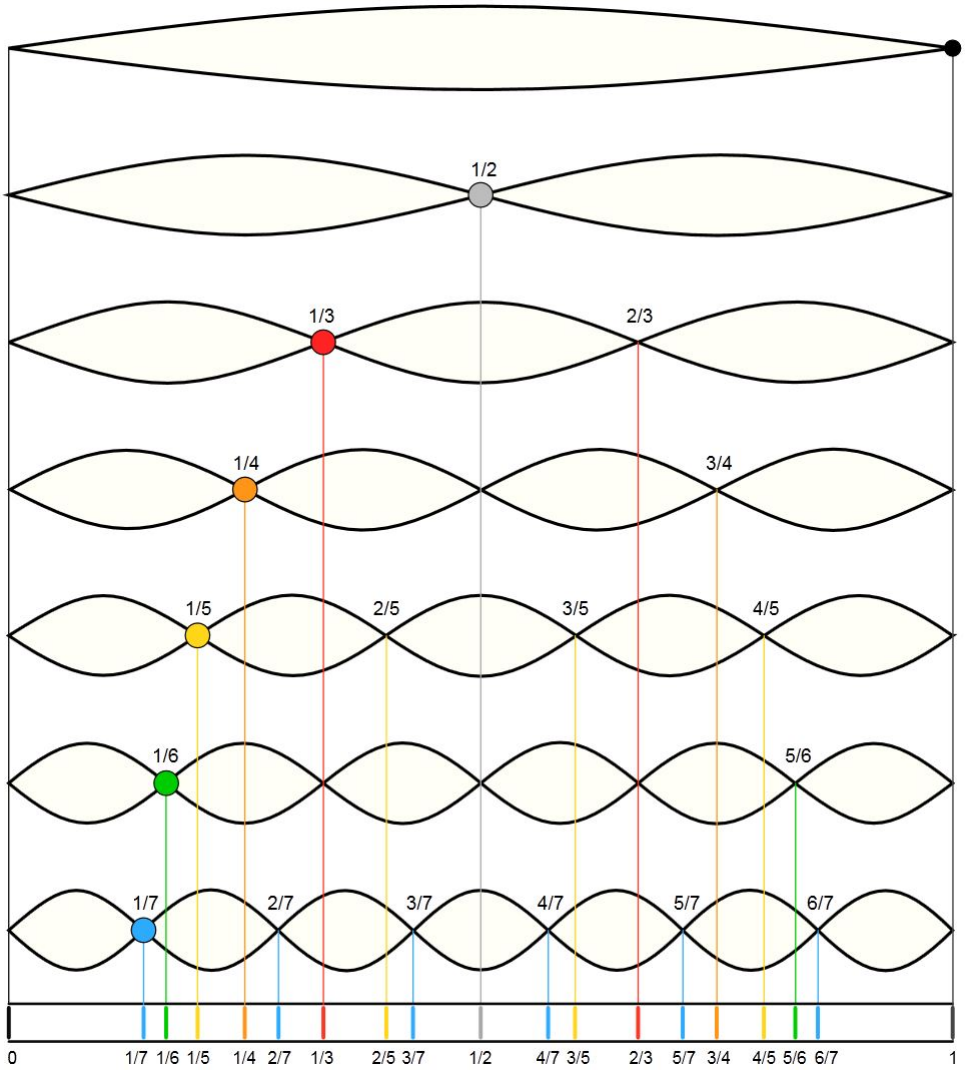
Name	Value in cents	Scale tone of "c"	Additional examples
unison, prima	0.00	c	
Pythagorean comma	23.46	his	des-cis, fes-e, a-gisis
double dim. third	66.76	eseses	cis-eses, eis-ges
limma, min. second (diatonic semitone)	90.22	des	e-f, cis-d, des-eses
maj prima greater (chromatic) semitones	113.69	cis	cis-cisis, des-d, eses-es
dim third	180.45	eses	cis-es, e-ges
whole tone, maj. second	203.91	d	d-e, e-fis, b-c, des-es, cis-dis
double aug prima	227.37	cisis	ces-cis, deses-d
double min third	270.67	feses	cis-fes, fis-b, cisis-f
min third	294.13	es	d-f, es-ges
aug second	317.60	dis	des-e, es-fis
dim fourth	384.36	fes	cis-f, fis-b, dis-ges
maj third	407.82	e	d-fis, eis-gisis
double aug second	431.28	disis	ces-dis, es-fisis
double dim fifth	474.58	geses	cis-ges, disis-a
fourth	498.04	f	d-g, ces-fes
aug third	521.51	eis	des-fis, deses-f
double dim sixth	564.81	aseses	cisis-as, cis-ases
dimfifth	588.27	ges	cis-g, h-f, e-b
tritone, aug fourth	611.73	fis	f-b, des-g
double aug third	635.19	eisis	des-fisis, eses-gis
dim sixth ("wolf interval" of Pythagorean tuning)	678.49	ases	cis-as, gis-es
fifth	701.96	g	d-a, dis-ais
double aug fourth	725.42	fisis	des-gis, deses-a
double dim seventh	768.72	heseses	cis-heses, cisis-b

min sixth	792.18	as	d-b, dis-h
aug fifth	815.64	gis	des-a, eses-b
aug seventh	882.40	heses	cis-b, gis-f
maj sixth	905.87	a	d-h, es-c
double aug fifth	929.33	gisis	des-ais, deses-a
double dim octave	972.63	ceses	dis-des, disis-d
min seventh	996.09	b	g-f, des-ces
aug, sixth	1019.55	ais	des-h, deses-b
dim. octave	1086.31	ces	cis—c, des—deses
maj seventh	1109.78	h	cis-his
double aug sixth	1133.24	aisis	ces-ais, eses-cis
dim ninth	1176.54	deses	dis—es, eis—f
octave	1200.00	c	

Table 3. The Table of intervals of the Pythagorean tuning.

3.4 The natural tuning

Natural tuning is a music system that uses intervals that are based on the overtones. Octave (1 : 2), fifth (2 : 3), fourth (3 : 4), major third (4 : 5), minor third (5 : 6), major whole tone (8 : 9), minor whole tone (9 : 10), and diatonic semitone (15 : 16). The result is an absolutely balanced range of initial tone, but only within the range of this tonality. And even within range of a seven-tone scale there are false intervals, such as the wolf fifth "d" - "a", appearing in the cadence of C F G C.



Picture 1. Equal temperament.

Natural seven-tone scale. This scale can be considered as a modification of the Pythagorean scale, in which the Pythagorean third was replaced by a natural one (4 : 5) by Didymus about 100 years after Pythagoras.

C	Whole tone	D	Whole tone	E	Semitone	F	Whole tone	G	Whole tone	A	Whole tone	H	Semitone	C
	204 cents		182 cents		112 cents		204 cents		182 cents		204 cents		112 cents	

Table 4. Natural seven-tone scale.

Expansion of up to twelve tones - extended natural tuning. Twelve-tone scale is obtained by calculating the five missing tones. If you use a diatonic semitone (15 : 16), you can get a perfectly rational frequency intervals correlation.

Name	Difference of frequencies and the keynote	Musical interval	Connection to the circle of fifths
C	1:1	0.000 cents	
des	16:15	111,731 cents	maj third down of "F"
D	9:8	203,910 cents	
es	6:5	315,641 cents	maj third down of "G"
E	5:4	386,314 cents	maj third up of "C"
F	4:3	498,045 cents	
fis	45:32	590,224 cents	maj third up of "D"
G	3:2	701,955 cents	
as	8:5	813,686 cents	maj third down of "C"
A	5:3	884,359 cents	maj third up of "F"
b	16:9	996,090 cents	
H	15:8	1088,269 cents	maj third up of "G"
C	2:1	1200,000 cents	

Table 5. Twelve tones - extended natural tuning.

Distances between adjacent tones (semitone) are not equal and have names:

Name	Musical interval
Diatonic semitone	111,731 cents
Major limma	92,179 cents
Chromatic semitone	70,672 cents

Table 6. Names of distances between adjacent tones.

3.5 Equally tempered scale

Evenly tempered scale is a musical tuning in which each octave is divided into a mathematically regular intervals, often for twelve semitones. This system prevails in the European professional music from around the XVIII century until our time. The immediate precursor of equally tempered tuning in Europe was a "well-tempered" system - a whole family of irregular temperaments, nevertheless allowing completely successful play in any tonality. One of the theorists of such tuning was Andreas Werckmeister – a German composer and organist. One of the first theorists of the new system equally tempered tuning were V. Galilei (father of Galileo) and M. Mersenne. The new system had many opponents, equally tempered tuning broke the strict proportion of intervals, and as a consequence, there began to appear minor beats in chords. In the eyes of many theorists it was an attack on the purity of music. Andreas Werckmeister argued that all the chords, especially triads, in the new tuning become monotonous and symmetrical, whereas in the old tuning systems because of the unequal temperament, each chord had its own unique acoustic sound. But over time, equal temperament has gained recognition and became a de facto standard. The advantages of equal temperament and the fact that you can freely transpose a play by any interval up or down.

Equally tempered scale is easy to show in the form of measuring intervals in cents:

Tone	C1	cis	D	es	E	F	fis	G	gis	A	b	H	C2
Cents	0	100	200	300	400	500	600	700	800	900	1000	1100	1200

Table 7. Equally tempered scale in cents.

The following table shows the differences of intervals of the equally-tempered scale from the natural one:

Interval	Equally-tempered intervals in cents	Natural intervals in cents	Difference in cents
Tonic	0	0	0
Minor second	100	111.73	-11.73
Major second	200	203.91	-3.91
Minor third	300	315.64	-15.64
Major third	400	386.31	13.69
Fourth	500	498.04	1.96
Tritone	600	590.22	9.78
Fifth	700	701.96	-1.96
Minor sixth	800	813.69	-13.69
Major sixth	900	884.36	15.64
Minor seventh	1000	996.09	3.91
Major seventh	1100	1088.27	11.73
Octave	1200	1200	0

Table 8. The differences of intervals of the equally-tempered scale from the natural.

Equal temperament can also share another interval, not just one octave, into the whole number of equal steps. To avoid ambiguities in the English literature, for example, a widely used phrase "equal divisions of an octave", or its abbreviated form of EDO.

3.6 Well-Tempered Clavier

The Well-Tempered Clavier – is a series of works by Bach, consisting of 48 Preludes and Fugues for Clavier, combined in 2 volumes of 24 works. Full title is "The Well-Tempered Clavier, or Preludes and Fugues in all tones and semitones, both relating to major thirds, and minor thirds. For the benefit and use of teaching music to eager young people, as well as for special pastime of those already successful in this teaching, composed and produced by Johann Sebastian Bach - now the Grand Duke Anhalt-Köthen conductor and director of chamber music ", often used to refer to the product abbreviation WTC.

The first part was written by Bach in 1722, the second - much later, in 1744, full name, above, was written on the front page of the autograph of the first part, second part was titled simply as "24 Preludes and Fugues new."

Title of the work involves the use of a keyboard instrument, these works are usually played on the piano or harpsichord tuning which allows the music to sound equally well in different keys. A 12-grayscale equally tempered scale is used now in this tuning. In the times of Bach there used to be other tuning systems, this meant that the same work performed in different keys, sounded a little different, and the frequent use of chromatism and modulations created the impression of an out-of-tune instrument and dissonance. This imposed restrictions on the music of that era, and Bach wanted to show the musicians all the benefits of new musical tunings. Currently there are discussions about whether or not the equally tempered system, mentioned by Bach, was really tempered, or only came close to it. It is likely that Bach's clavier was set up in a good temperament of Werckmeister as indicated by the name of the collection.

Advantages of system used in the WTC are the possibility of modulations and chromatisms without restriction, as well as equality of all tones. Although the work of Bach was not the only collection of works for all keys, it became the most famous and compelling argument to move the new system. Subsequently, this led to the harmony becoming one of the foundations of classical music. Beethoven, whose works are often well beyond the modulation of the primary key was under

the influence of the WTC. Ability to equally use all keys and move freely from one to another to create a specific feeling in the listener was fully implemented in the Age of Romanticism.

Besides the use of all keys, WTC is known for many innovations of technology and means of expression. None of the composers, but Bach was able to create such a vivid and lively work in the form of fugues, and many of his followers checked themselves on his works. Later, other composers, inspired by the example of Bach wrote their collections of 24 preludes and fugues. For example, in the middle of XX century, Dmitri Shostakovich wrote a series of similar works.

4 DIFFERENT VIEWS

4.1 Pablo Casals

According to Pablo Casals no phrasing can replace inexpressiveness of fake sounds. He calls intonation the main part of phrasing. Accurate intonation has a huge impact on the development of technique and work on technique is physically in countless repetition of various movements of the hand and fingers. If the hearing does not control the job accurately, no repetition occurs. The idea of the intervals does not develop but deteriorates so much that the work goes to waste. Exercise in hearing begins with listening to the height of a sound. A full sense of the height does not occur immediately, but after some time after the beginning of the sound. It means that not only the string stands out that creates the basic tone of the sound, but also in-tune octave strings have been determined both up and down, the pitch was fixed in the musical consciousness. Then one gets a clear and accurate idea of the pitch, and also a nearby sound of the scale.

In weak sounds the pitch is perceived more acutely than in strong because of the easy resonance of adjacent strings, so Casals advised to work on intonation for "pianissimo".

It is recommended to form a first tetrachord of the scale, comparing it to open strings if possible, then the second tetrachord, carefully checking its intonation. We must also bear in mind one peculiarity of the human ear. For a complete musical satisfaction, it requires that the semitone of a tetrachord be somewhat smaller than its mathematical value, and the fourth tetrachords sound is not pitched down but pulls up an adjacent third sound. (Ginzburg 1958, 174.)

4.2 Siegfried Eberhardt

The problem of intonation also worried a German violinist, teacher, and the director of the Stern Conservatory of Music in Berlin. Eberhardt thought that along with the problem of expressive sound is a question about the absolute accuracy of hitting the note by the left hand, which requires maximum attention from both the teacher and the pupil. This accuracy or purity of intonation to a large extent determines the success of the way a violinist is going, as it affects the achievement of technique and its finality. Therefore, reliable technique of the left hand should be the goal of every violinist, to which he aspires through constant exercise, hard work, and which, unfortunately, very often is inconclusive. There are many reasons to explain this phenomenon. Eberhardt said:

> *I have often heard the uncertain and unsatisfactory playing by students whose abilities seemed to me far more important than the talent of other violinists, who were more confident performers. I have always believed that it is not so much the lack of talent, but an unnoticed error in the mechanics of motion that is the main cause of inaccuracy and uncertainty, and I have always proved it right in my research.*
>
> (Eberhardt 1910, 31.)

First, we should explain the notion of hitting accuracy in this special case. Education begins with the first position and develops the student accuracy in hitting the finger from top to bottom, this is the descending movement of the finger on the string. If a student has good hearing he in a relatively short time reaches the ability to play cleanly and confidently in the first position. Also the use of any other position is not a problem. The problem arises only when the connecting positions with each other. Nowadays, the requirements to the technical capabilities of the violinist are much higher than at the time of Corelli and Bach, technique within three - five positions then was considered quite sufficient, but is not anymore. A necessary condition for today's violinist is the perfect master of

the neck in its entirety, as a modern violin literature requires a much greater accuracy in motion around the neck than in the position of a single position. The word "accuracy" implies confidence in the transitions from one position to another. The most important part in the development in the left hand begins with changing positions. Here comes the crucial moment, whose use without precise knowledge of the necessary movements can be fatal for all further learning.

Very often you can hear the assertion that the sense of touch by fingers, including the fine ends of the nerves on the tip of the fingers plays an important role in the purity of intonation. If this were so, one would face the strange differences in the sense of touch. The blind, who have developed this sense of an extremely high degree, would be designed to become a brilliant virtuoso. However, cases in which the blind would achieve considerable success in the technique are very rare. Sense of touch and delicacy of feeling certainly must be present in a violinist, but they do not play a decisive role.

To come to grips with the desired motion in this case, one must first observe. Usually in connection with the movement of the fingers we see the brush moving in two directions from bottom to top and back, which takes place on the fingerboard.

Usually little attention is paid to the origin, the starting point of these movements. In fact, the hand and finger, which at first sight seem to play a major role, in fact, have almost no value in this confidence of hitting.

Hand and fingers, to the contrary, should not be actively moving, but must be following. Therefore it is wrong to speak of "leading" fingers like in double notes, as the finger does not lead the hand and forearm, but is rather guided by them.

In this case, it is important to know the following law: the moving group of muscles is always located higher than the guided one. For example, when a particularly strong movement should be passed to the forearm in the first place it requires the participation of leading that is, moving group of muscles on the humerus and shoulder joint. Since the hand is a driven part of the arm, then it's

possible independent movement, as well as looking for finger movements occurs even in relatively advanced technique is definitely harmful to the achievement of complete purity of intonation. In this regard, vibration may have a particularly adverse impact, which often turns into an active vibrational motion of the hand. Cautious approach to vibration frequently observed in teachers is the result of perhaps the instinctive assumption that it is the main source of errors. If done correctly, the activity of the humerus is observed, on the condition that vibration should never turn into isolated rocking motion of the hand. This movement has its roots in the humerus and a motor impulse to the forearm in the conjunction with the hand. To pass the initial movement, it is necessary to keep hand at the wrist free and easy. It is necessary to avoid too much self-sufficient active motion of the hand coming from the wrist, and to avoid the strain of the wrist, it is recommended not to make excessive finger hits.

Eberhardt considered the training of the thumb very important, although minor. The most important condition is to remove the pressure of the thumb on the neck of the violin in the hands during the transition to the next position. The position of the first finger can also lead to self-motions of the hand and thereby disrupt the sense of confidence in playing.

In the first four positions the neck must be kept quite easily between the thumb and the base of the index finger. Only this can ensure the smooth provision movement of the hand, not disturbed by irregular counter movements. The hand being really driven and not leading, is seen by comparing the violin with the cello. The leading activity of the hand in this case is even more obvious, as distance between the positions of the cello is greater than a violin. In addition, the hand during playing the cello is much easier and relaxed, as one does not need to hold the instrument and the hand is not strained.

The following exercises to develop purity of intonation are based on the right movements of the upper part of the arm and are the most effective way of training. This method is the opposite method by Ševčík. Ševčík is based on the simplest forms of exercise to gradually come to the most complex combinations. Thus, he seeks, through the transition from simplest to the most complex, repeating the

same exercises again and again, to achieve the required correct motions. When the movement in its basic form is incorrect, it is unlikely that it will gradually become more correct through constant practice in more complex combinations.

Eberhardt is of the opinion that the exercise should immediately depend on the required movements, but not on when the proper motion is generated as a result of prolonged exercise.

In conclusion, we will briefly list the main conditions crucial to the development of clean intonation:

1. The correct training of the thumb.

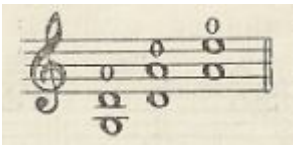
2. The correct training of the first finger.

It is recommended to avoid uncertain "searching" movements of the fingers, excessively energetic self-motion of the hand, false vibration.

The main condition is the development of a leading group of forearm muscles on the bones and shoulder joint. To avoid frequent tension, that inhibits playing, we recommend that after a while one should lift the arm for some rest. A feeling of lightness in the forearm and the absence of tension is a basic condition for overcoming the technical difficulties. (Lesman 1964, 126.)

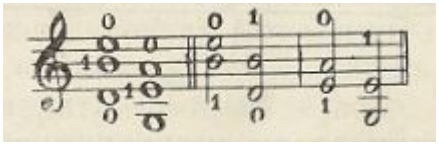
4.3 Otakar Ševčík

Otakar Ševčík in his writing pays much attention to the disadvantages of tuning violin by perfect fifth. Before the introduction of temperament the piano could be played only in a few, chord tones of keys that are far from "C", were not more in a harmonic relationship with this tone. Also tuning up a violin by pure fifths is not without influence on the intonation of the instrument. Despite the fact that in tuning up a violin only the following three pure fifths are used:



Picture 2. Three pure fifths.

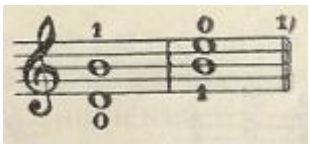
Difference between the perfect fifth, and their equivalent in equally tempered scale is still present. The violinist will notice that you cannot play some chords with absolute purity. If you take a pure quart of "h" - "e":



Picture 3. Example of pure quart of "h" - "e".

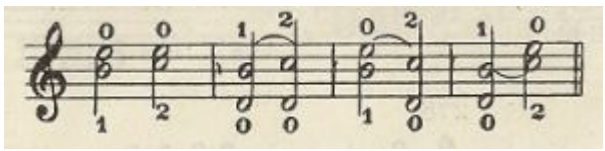
Then note that "h" in the sixth "d" - "h" will be high. To take a the first chord absolutely purely, we would tune the first string "E" a little bit lower and the third string "D" a little higher. In the second chord one would have to increase slightly the fourth chord "G". But the temperament of the open strings on a violin is not applicable, since the entire violin technique is completely built on a system of pure fifths.

The need to tune up the violin by perfect fifths makes one take the same note range in different ways, depending on whether these are notes of the harmonic interval from the top of an open string or the bottom. Sounds which form an interval with the top open string should be drawn slightly higher than those that form the interval from the bottom string. For example:



Picture 4. Example of intervals with the top open string and the bottom string.

The first finger on the note "h" of the second bar should be moved about 3 mm upwards. Problems can occur with semitones as in this example consisting of four measures:



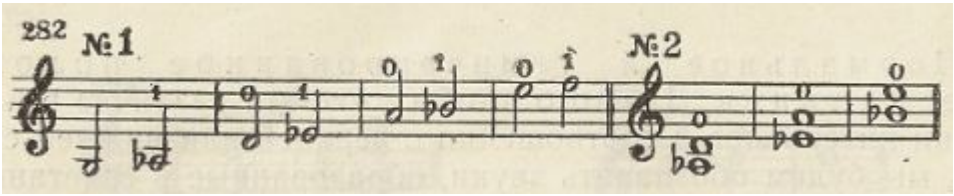
Picture 5. Problems with semitones.

For the formation of a semitone "h" - "c" fingers should be placed in different locations for each bar on the neck. In the first step the semitone is the highest position in the second it is in the lowest in the third one the distance between the fingers is the smallest and in the fourth one is the highest.

In order to clarify the difference in tone intervals in relation to the top or bottom string, we should call sounds, formed in conjunction with the lower string "normal tones," and those that are produced in conjunction with the top string – "tempered tones," "normal" and "tempered" position of fingers. In tempered position the distance between your index finger, thumb and the head of the violin is about 3

mm higher than in the normal position. Low position of the index and middle fingers in the normal position results in the violinist putting his fingers too low, and playing out of tune. To avoid this, you need to use high position (tempered) in all the notes with sharps and also in the notes with flats to the keys in which you can use open strings. Others require a normal low position of fingers.

In the normal situation you should be wary of putting the first finger too low, to which we are always inclined, playing the next semitones:



Picture 6. Two examples with open string and first finger.

Here it is necessary to adjust the index finger to the top of the open string (Example 2). Without meeting this condition scales will sound too low.

All these examples prove that the exact tone of the violin is a very complex area that is heavily dependent on the temperament of different intervals. It is quite impossible to achieve tones by mechanical means. Perfect intonation is entirely the work of the mind and ear. Before playing the sound should be born in the brain and then the nervous system transmits signals to each finger in the individual sequences so that the finger rests on the string at a certain point, not too high nor too low. This relationship between the ear and fingers, especially in fast passages, requires perfect knowledge of intervals and their ability to form thoughts. A quick glance at the printed note should be enough to make the sound.

The Ševčík technique implies seeing the sheet with music and reproducing sound at the same time, rapidly forming intervals and chords in mind, regardless of the development level of the left and right hands. Perfecting the technique to gradually move to the exercises in different higher positions learning them the

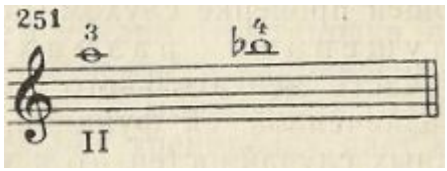
same way as in the first position. Thus, over time, the player will master all the positions. We can say that a violinist plays a few different instruments, not just one, because each of the top positions in reality is an independent instrument but of a smaller size, for instance the sixth position is the same size as the half-size violin. To achieve mastery of each of the seven or ten instruments is very important for the technical completeness of the violinist. Training must proceed in a moderate tempo, with the need to immediately fix each intonation error. In the fast tempo one can hardly notice their mistakes so exercising should alternately be at a slow and a faster pace. (Mostrass 1962, 139-145).

4.4 Carl Flesch

Austrian violinist and pedagogue Carl Flesch said the main goal of the work on intonation is the correct performance of a particular amount of a certain sequence of sounds in a particular tempo. This purpose is served by all the mechanical actions that occur in the left hand. Before proceeding to a detailed consideration of Flesch methods for the technique of the left hand, let us find out what he saw as the problem of purity of intonation.

Although the violin has only four strings, we can perform approximately 53 different sounds in the half-tone system. Add to that the differences not only in pitch, but also the color of sounds differing from each other, we get much more. To this we must add harmonics and double notes. Performing a different sound from the sound of the open string we shorten it, that is by putting your finger on the string we separate the part from another part of the string and prevent it from vibrating. Under the laws of acoustics, every sound has a certain number of oscillations, if they occur in the right amounts, we perceive the resulting sound as clean, if not - it seems false. Helmholtz’s research has shown that this striking phenomenon of counting vibrations is produced by the Corti's organ in our ear for the smallest fraction of a second, but new research partly questions it. For our purposes it makes no difference whether we know exactly where the counting of

oscillations of the sound occurs, it is more important that we have seen this fact. From this it follows that the notion of "pure playing" should mean that we create a sound at the point where by shortening the string we achieve the required tone. Is this possible? To answer this basic question, consider the two sounds on string "A":



Picture 7. The two sounds on string "A".

They both differ from each other only by 60 oscillations. The distance from the notes on the fingerboard "a" to "b" is approximately 2 mm, so 60 oscillations spread within 2 mm, therefore a single oscillation is 1 / 30 mm. Imagine that we played a note of pure "a" then to take a purely mathematical "b" you must put your finger on the string in such a place, the accuracy of which is set to 1 / 30 mm. You can imagine such a possibility, but only if the pressure on the string is exerted by a subject, which has a surface of 1 / 30 mm, that is, obviously not a finger the tip surface of which is about 10 mm. Even if we admit the possibility that with much luck we do fall into place with an accuracy of 1 / 30 mm, then the sequence of notes played, for example, in a scale, makes this precision absolutely impossible. Therefore, we must recognize that the "pure playing" in the physical sense is impossible. (Flesch 1964, 50-53).

However, there are a lot of violinists, whose playing gives the impression of as being clean. How can we explain this contradiction? The reason is that though these violinists do not tap the right sounds precisely within a split second they fix them either by move the finger, or by vibration directed toward the clean sound. With good skill it happens so quickly that the listener thinks that the sound was clean from the start, although it was only after a minimum period of time. Therefore, the "pure playing" - is nothing more than a quick, deftly performed

correction of an initially inaccurate sound. When playing false the sound remains false throughout its length. Highly prevalent view states that the cause of a false playing is to be found in pure dexterity and in the wrong hand movements. In fact, the main cause of this problem is the lack of hearing. To explain this fact let us briefly describe the phenomena that occur in us while fixing false sounds.

Once we have set a string in motion, its vibrations reach the ear through the auditory center in the cerebral cortex. Our mind analyses it whether the sound was pure or false. If it is false the artists who have the acute hearing, have an extremely unpleasant sensation that causes a corrective movement of the fingers. The more unpleasant the feeling, the stronger the need to achieve the correct pitch as soon as possible. This change in the position of fingers changes the number of oscillations. As we can see, the correction is only due to discomfort. This is the essence - the perception must quickly respond to the motion followed. Indifference creates immobility; boredom even makes facial features harden. Only the intense desire or reluctance provokes the appropriate motion. So, it all boils down to ensuring that our hearing is so acute, that the false sound evokes an unpleasant sensation that generates this automatically correcting motion.

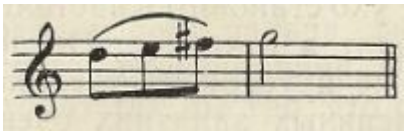
From these considerations, Carl Flesch has applied for many years to his disciples special hearing exercises, such as Rode Caprices. It implies that a student must keep every single sound for as long checking its accuracy without vibration as possible, through an open string, until he is convinced that they achieve the exact pitch. After several hours of such exercises there is one phenomenon that at first glance intimidates a student, if he had not been previously prepared for this: it seems that his playing is much more false than before. What happens in reality? By contrasting the pure and false sounds the ear is so sensitive that the student is in despair. After the teacher explains this phenomenon and calms the student down, with further regular and intensive training very soon, usually within a week, there is such a significant improvement that the student can determine the purity of sound and correct it within a second, although this correction takes place in a noticeable way. (Flesch 1977, 58).

This first and most important period of intonation exercises Carl Flesch considers complete only when the student, even in a slow, melodic work, which he performed with real feeling, and not as an exercise, instinctively corrects sound. If he has already achieved this, you need to bring to his mind that the correction of each false sound should form the basis of his art and what has been achieved as a result of the large improvement in his hearing disappears when he begins to refer to intonation neglectfully, and his hearing organ becomes accustomed to an inaccurate determination of the number of oscillations of sounds performed. It is necessary to convince students that in addition to other benefits, slow exercises provide an opportunity that every sound can be checked and corrected. It is necessary to point out that the wrong hit, setting of finger on the string is not an error, if the sound is fixed so quickly that the original, incorrect pitch will not have time to reach the consciousness of the listener. If the performer hears a false sound and does not fix it, then this negligence usually leads to indifference, which will always hinder to move forward. The violinist should never forget that acute hearing is his most precious possession, and is essential in achieving high skill.

It is known that the height of a sound in spite of the same symbol may be different, depending on its relation to one or the other harmony. For example, we know that the sound should be taken higher, if it occurs as an introductory tone of the VII scale tone than if it were a sustained third of the III scale tone. So we play a note "fis" in the following example, with the usual major third tone:

Picture 8. "fis" with the usual major third tone intonation.

Then, as in the example where "fis" is a step VII:

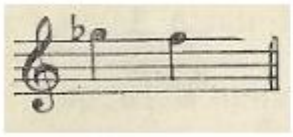


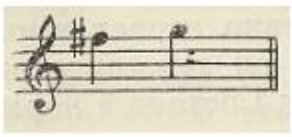
Picture 9. The example where "fis" is a step VII.

We will play "fis" several oscillations above, since it tends to the tonic "g". In this case, "fis" - "g" is reduced to a certain number of oscillations of a semitone, called in musical practice "quartertone."

You can usually distinguish between two types of violinists playing "pure." Few can use the "quartertones", most are quite satisfied if they are playing in equally tempered tuning of the piano, so they have the same sound "fis" and "ges", while there is a significant difference between these sounds.

Let us consider the following examples:

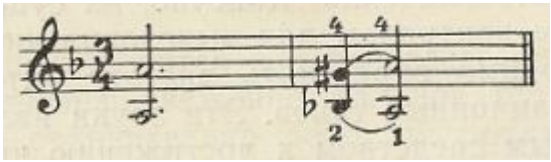
1. 

2. 

Picture 10. Two examples with "ges".

In the first example "ges" is 12 oscillations lower than "fis" in the second example, so in both cases, semitones must be played very tightly, it should be noted that the "f" and "g" retain their physical height, whereas the "ges" and "fis" are diminished or augmented.

Every violinist is aware of the problem of pure performance of the following location of the first part of the Violin Concerto by Brahms:



Picture 11. Two bars of the first part of the Violin Concerto by Brahms.

Practically there is only one correct way - "b" should be taken too low, and "gis" in accordance with the introductory tone should be taken high. When playing the piano one should remember that the diminishing and augmentation of introductory tones must not go much outside equally tempered scale.

In these examples we can see that although in theory it is possible to set the number of oscillations of each of sound, in practice, we rely solely on our ear, and in each case adapt to the intonation.

Correction of the sound requires a certain amount of time, the duration of which depends on the individual hearing ability and finger technique correction. Corrected sound can last for about half a second to consider correcting successful. The shorter the note, the more important dexterity is. If we do not have enough time to carry out such a complex operation, one should achieve such a level of dexterity as to immediately take some pure sound. If you immediately require pure intonation from the student, during an important period in his violin playing skills development when he is still not able to do it, there may be a subconscious delusion, which in its further development leads to the indifferent neglect of all other sound and technical shortcomings. Our demands for absolutely pure playing will decrease when the tempo in which we play a series of sounds, is accelerating. A good example is the difference between slow and fast scales or broken triads. In the first case, the human ear perceives with great attentiveness the inaccuracy of each sound, and that is why it is incredibly difficult to play a series of notes slowly with absolute purity, while it is relatively easy to play a scale quickly to the satisfaction of sophisticated listeners. (Mostrass 1962, 137.)

According to Flesch the effect of "auditory illusions" when there is a lower third sound, which is obtained from the simultaneous sound of two sounds of different heights, is not so important in practice. Of course its existence is a useful control to determine the purity of the intervals, but it is necessary to determine the purity of intervals without the aid of auditory illusions. These sounds are not direct, but an indirect means to achieve a clean tone.

To conclude this section we would like to explain the term "sure left hand" - the ability to hit certain places of the neck with the lowest deviations.

4.5 Nikolay Garbuzov

Nikolay Garbuzov is a Russian music theorist and acoustician, Doctor of Arts, head of the State Institute of Musical Science, and director of the Research Institute of the Moscow Conservatory from 1934.

Studies of Stumpff, Meyer and other scientists guided Professor Garbuzov to the idea that the musical ear has an area origin. For example with notes "a", "c", "fis", "d", etc. we do not denote one particular oscillation frequency ("a" being equal to 440 Hz), but the band of frequencies close in value. Combinations of sounds "c" - "e", "g" - "d", "f" - "g", etc. do not give us any definite mathematical relationship between the sounds (5 / 4, 3 / 2, 9 / 8, etc.), but give us bands close in magnitude of mathematical relations. (Garbuzov 1980, 16.)

Frequency bands within which the sound and range retain their individuality were called zones by Garbuzov.

Further works by Garbuzov showed that people with perfect pitch the width of zones of individual sounds largely varies depending on the register, timbre, loudness and individuality of the performed sound, the width of interval zones varies from 24 to 76 cents.

Garbuzov also found that within each interval zone the ear distinguishes from 10 to 15 of intonation - shades of the zone. Each tone corresponds to objectively narrow band close to the value of mathematical relationships between sounds.

All these discoveries allowed Professor Garbuzov to advance a hypothesis about the origin of modern music system, and explain a number of musical events. In this hypothesis, the musical system is twelve-zoned, not twelve-sounded. This system did not appear mathematically, but by hearing screening interval zones with strong personality, there are12 of them within an octave, followed by functional integration of these areas. Garbuzov's hypothesis was fully confirmed in studies by Korsunsky and Garbuzov himself.

They studied the system in which the violinists Zimbalist and Elman sang a melody first twelve bars of Bach's aria from Orchestral Suite "D-Dur", edited for violin and piano by Wilhelmy. These studies showed that sounded intervals cannot be put into the framework of any known system - equally tempered, twelve-sound, Pythagorean and natural. These intervals are so diverse in size, that a system, in which they are performed, can only be called "systems of a given performance." This unique structure is the result of interaction between the band and the nature of musical ear "tonal art" of the musician, performing a tune.

Some trends to the Pythagorean system, the chromatic semitone being larger than diatonic, augmented fourth being larger than a diminished fifth, etc., noticed in the performance of Zimbalist and Elman, are due to the fact that the violinists in intoning the neighboring intervals, minor and major seconds, minor and major thirds and, etc., tend to reveal the identity of these intervals more brightly, and carefully avoid their neutral sound.

5 TECHNIQUES AND PARTICULARLITIES AFFECTING THE TONE OF THE VIOLIN

5.1 Research

Intonation is one of the thorniest issues in the art of violin associated with artistic expression, musical performances and auditory sensations of the performer. The concepts of "true", "clean", "good" tone are rather strongly blurred, so it is better to speak about the accuracy of expressive intonation, its artistic, rather than a formal sense. Intonation is inextricably linked with all the components of music - tone, phrasing, dynamics, stylistic features, etc. Intonation inaccuracies speak not only of negligence, lack of preparation of a musician, they point to a mismatch in the action of auditory and motor mechanisms, disrupting in the process of realization of artistic ideas. (Grigoryev 2006, 99).

As we mentioned in Chapter 4, views, methods and ways of solving the problem of intonation are quite different, and often contradict each other. We started with the features of a musical ear, and looked at the historical development of the most interesting theories and methods of work of many well-known and respected teachers from around the world. Therefore, in this chapter, we try to integrate all the theoretical knowledge, analyze, and, based on them, to identify patterns that will help us in practice to control the tone and avoid making the most common mistakes.

Let us single out the basic laws of artistic and expressive intonation for practical exercises:

1. Tonality and harmony system, the characteristics of each tone in a written work and in which the mind of the performer develops.

2. Specificity of "acute" quarto-quint tune of the violins, unlike the evenly-tempered piano tuning, with which the violin often plays in the ensemble.

3. The difference between the two main types of intonation:

- Artistic and melodic, based on the Pythagorean order.
- Harmonic based on a equally tempered scale.

4. The dependence of the intonation on the pitch and the nature of performance: performance dynamics, tempo, timbre, register, and also on the characteristics of vibration, sound attack, and other performance techniques.

5. Formation in each performer a subjective, individual artistic and intonation system, which is explained by the zone nature of hearing and is a natural process of development of musical talent, unique to the violinist.

Let us now consider some details of these laws.

5.2 Tonality and harmony system

Modern European modal system is significantly different from the systems of the past centuries. The concepts of consonance and dissonance, harmony, gravity of scale tone, and other categories have been drastically changed. Even the familiar major and minor have long since lost its dominant role in contemporary art, and their characteristic intonation link. You cannot forget about the modal patterns of folk music underlying many works by composers of the XX century. For example a violin concerto by Khachaturian, based on non-octave tonality of Armenian folk music, the tonic of which is not the tonic triad but tonic seventh chord. Semitone gravity, in particular the introductory tone, gets a different sense of intonation, where the rise of melody is associated with increased tone and vice versa. In this connection there is a need for information about tonality and harmony system side of the work, its style. One also needs to understand that the movement, the development of art itself is changing musical thinking, which affects the perception of the music of past centuries, including its top layer - the intonation. (Yankelevich 1993, 102).

5.3 Specificity of the violin tuning

Pythagoras tuning with the broad structure of the violin fifths reflects the modal patterns of musical thinking, it largely determines the tone upbeat modal sequences - scale. It has an exacerbated intonation of minor seconds, respectively, the restriction of quarts and minor sevenths, major sevenths expansion.
This abstract intonation, which is often brought up from childhood, cannot give a truly expressive intonation in playing works of different styles and different national cultures.

For example, "pure" intonation of "D-Dur" in the Beethoven concerto or sonata by Prokofiev will be significantly different from each other due to the influence of the most important factor - the art.

It should be remembered that high-rise intonation of different tones of the violin is a consequence of non- tempered tuning. The lowest tuned in relation to the structure of a piano is string "G", and the highest - string "E". Accordingly, the lowest dark tonality is "G-Dur \ moll", the highest, light - "E-Dur \ moll", that is not always realized in practice by performers. (Yampolsky 1968, 83).

There is also the most important issue for Violinists: playing, accompanied by piano. There is a perception that it is necessary to bring together intonation of the violinist with tempered tuning of the piano, especially in the sonatas and ensemble works, because of the marked difference in pitch, especially in unison places. But there is another point of view, supported by D. Oistrakh. Zone nature of our hearing allows, as already mentioned, a significant breadth of "clean" sounding of a note. The difference between playing a sound in the ensemble can be quite large, while narrowing a zone is perceived as a loss of hearing of some colors of sound, dry sound. In addition, a violinist vibrato dramatically expands the scope of high-rise intonation, "overrides" the tempered zone of the piano. Many eminent violinists did not change their intonation when playing in an ensemble with piano, achieving a singular artistic expression of joint sound, special intonational stereo panorama, painting tempered piano tuning with specific colors, sharp tone of the violin, thus correcting temperament in a required art direction.

5.4 The distinction between melodic and harmonic intonation type

The difference between the melodic and harmonic intonation is required to match the "vertical" - double notes and chords, to get their proper harmony. This difference is big enough. For example, in the performance of major third of a major triad, it is 1 / 10 of a whole tone. Consequently melodic intonation is not possible in playing double notes, chords and polyphony, which has its laws. A. Yampolsky advised when playing double notes to create not a single entity, but a duo with the full sound of each note in it, which combines the "vertical" tone with the "horizontal" melodic.

The work by Tartini on "auditory illusions" is based on the achievement of pure intonation, harmonic structure, which leads to the summation of the frequencies in the human ear and the appearance of illusorily sounding more low-pitched tone. Melodic intonation does not lead to such an effect. this recommendation should not be taken literally, as in the process of artistic performance and it is possible and sometimes required to intone double notes and chords in a melodic system, achieving the desired result, as well as melodic parts, especially in the polyphonic works, to intone in the harmonic structure. (Grigoryev 2006, 102.)

5.5 Dependence of the intonation on the pitch and nature of the performance

Complex mechanisms of intonation are strongly associated with all the performing process, almost any change in the playing immediately reflected in the perception of the pitch of the note performed. This is especially true of different tonal coloration of sound - a lighter shade, which contains many high overtones markedly increases the perceived pitch and vice versa. The change of harmony on one sound effect also leads to changes in pitch. When moving the bow from the stand to the neck there is a psychological effect of lowering, "browning" of sound, and on the contrary when moving the bow from the neck to the stand – the rising of the sound. In multiple repetition of sound, due to saturation of hearing, there may be loss of acuity of its perception. For example at the end of Tchaikovsky's

works "Reflections" the repeated minor second in the upper register A. Yampolsky advised imperceptibly and gradually move upward, thereby avoiding seeking enlightenment and darkening of sound.

The perception of pitch is strongly determined by the tempo of performance, the passage well trained in slow motion, can suddenly turn out to be not so clean up to tempo. This is because in slow motion the ear attentively compares the neighboring sounds, and at a faster tempo auditory connections gradually drift apart, an effect sound complex occurs, in which the melodic intonation goes into a harmonious with the tonic and dominant being the only stable scale tone. In addition, the shorter the sound, the less accurately the ear determines its sound quality of high-rise. Fast passage is based on two or three notes to play a major role in its intonational expressiveness.

One of the most obvious influences on the pitch is determined by a dynamic performance. A loud sound is perceived slightly higher than the quiet. With increasing pressure of the bow on a string and increase its speed there is a slight increase in tone. However, clamping the string has the opposite effect - a decrease in height.

Change in pitch is the same when playing special methods of getting sound. The effect of increasing is observed in playing: at the stand, with bow stick. The effect of lowering the sound in playing: a mute, on the neck and in the performance of natural flageolets.

It should also be remembered that our ears need overstatement of intonation in the high register to compensate for the physical perception of pitch. Only in this way it is perceived as pure and sonorous. (Yampolsky 1968, 74.)

6 CONCLUSION

The purpose of this research is to study the problem of applying and improving the violin intonation. I reckon the tone is one of the thorniest issues in violin art. It is associated with artistic expression, musical performances and auditory sensations of a performer. There are typical comments on the violin tone: "play cleaner", "play in the key", "here you have to play a little lower (due to the nature of harmony)", "here play a little higher". Art of the Violin is largely based on individual, subjective feelings and perceptions of both the performer and the listener. In their minds, many elements: pitch, rhythm, amplitude, their various forms, the presence of harmonics and other, are connected and lead to the birth of the individual inner sense of sound, which is compared with the real, external sound and is corrected. The concepts of "true", "clean", "good" tone are rather blurred. I think it more appropriate to speak of expressive accuracy of intonation, of its artistic, rather than not formal sense. Intonation is inextricably linked with all the components of music - tone, phrasing, dynamics, stylistic features, etc. Intonation inaccuracies speak not only of negligence, lack of preparation by a musician, they also point to a mismatch in the action of auditory and motor mechanisms, disrupting the process of translating artistic representations.

It is known that in order to intone purely on the violin, you must have developed a musical ear, ear coordination with movement, correct motor skills. In this work I have been interested in the ability to measure: how much is "slightly higher" or "below" to play each note to achieve optimum intonation. I am also interested in what units would be possible to measure the required accuracy of intonation (millimeters per cent, hertz ...).

In the first chapter, I explored the musical ear and hearing activity, the ability of each individual in different ways to perceive and respond to musical sound. The sensation of violin sound is one of the most important components of intonation. I also examined the psychophysiological component of the hearing - the phenomenon of auditory illusions, "color hearing" possessed by many world-famous composers (Mozart, Rimsky-Korsakov, Scriabin, and others).

In the second chapter of this work, taking into account that the problem of purity and accuracy of intonation has been a focal point in music for a long time, I traced the movement of theory in the field of intonation based on the example, of the doctrines of harmony until the Bach era. Some of these studies (Pythagoras order, natural pitch, evenly tempered scale, well-tempered scale), we have examined in more detail. Thus, underlying the Pythagorean system is a way to build relationships between the sounds of a certain height, which is usually represented as a sequence of fifths or fourths. Natural pitch implies using intervals that are based on the overtones. In the evenly tempered scale each octave is divided into mathematically regular intervals, often in twelve semitones. This system has prevailed in the European classical music since around the XVIII. A number of works by Bach are considered a model of well-tempered scale, consisting of 48 Preludes and Fugues for clavier, combined in 2 volumes of 24 works. It is known that Bach's work was not only a collection of works for all keys, but it was the most convincing argument for the transition to the new regime. Subsequently, this led to the harmony becoming one of the fundamentals of classical music.

In the third chapter of my work, I presented the views of the various musicians on the violin tone. For example, Pablo Casals called intonation the principal part of phrasing and finds that no phrasing can replace the inexpressiveness of false sounds. Siegfried Eberhardt, a German violinist, teacher, director of the conservatory Stern in Berlin from 1935, believed that along with the problem of expressive sound is a question about the absolute accuracy of hitting the note by the left hand, which requires maximum attention from both the teacher and the pupil. Otakar Ševčík in his writings pays much attention to the disadvantages of tuning the violin by perfect fifths. The idea of Ševčík’s method is to see the sheet music and reproduce sound at the same time, rapidly forming intervals and chords in mind, regardless of the development of the left and right hands. Carl Flesch, an Austrian violinist and teacher, believes the main purpose of the work on intonation is the correct response to a known amount of a certain sequence of sounds in a particular tempo. This purpose is served by all the mechanical actions that occur in the left hand. Underlying the approach of Nicholay Garbuzov, Russian musical acoustician, theorist, Doctor of Arts, is the idea that the musical ear has a zone origin. Professor N. Garbuzov hypothesized about the origin of the

modern musical system, and explained a number of musical phenomena. According to the hypothesis put forward by him the musical system is twelve-zoned, not twelve-sounded. This system did not come through mathematical calculations, but by hearing screening interval zones with strong personality. There are 12 of them within an octave, followed by functional integration of these areas. Garbuzov's hypothesis was confirmed by further researches.

In the fourth chapter, I examined a number of techniques and features that affect violin intonation. This chapter highlights the main patterns in the artistic and expressive intonation that should be considered in practical exercises:

1. Tonality and harmony system, the characteristics of each tone in a written work and in which the mind of the performer develops.

2. Specificity of "acute" quarto-quint tune of the violins, unlike the evenly-tempered piano tuning, with which the violin often plays in the ensemble.

3. The difference between the two main types of intonation: Artistic (melodic) and Harmonic.

4. The dependence of the intonation on the pitch and the nature of performance: performance dynamics, tempo, timbre, register, and also on the characteristics of vibration, sound attack, and other performance techniques.

5. Formation in each performer a subjective, individual artistic and intonation system, which is explained by the zone nature of hearing and is a natural process of development of musical talent, unique to the violinist.

Generally, my research has proved that it is impossible to bring the musical tone to strict rules and laws. This is the deeper meaning of music in general, and intonation, as one of its parts, in particular in the choice and individual approach to performance and expression of one's feelings and emotions. To be successful, knowledge of theory and all the rules alone is not enough. It is necessary to create music and realize oneself in it, based on these rules and knowledge.

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