

From the three different major seconds to the hand-signs – focus on pure intonation

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As a result of technological progress, MIDI recordings and digital choral parts are available to choir leaders to facilitate the rehearsal and learning process. However, what on the one hand seems modern and innovative (digital pianos, audio and video recordings, streaming, virtual choirs) can have a negative impact on the other.

The following chapters will point out why reading music with a relative system of solfa is beneficial, and why learning to sing a part or a choral work with the help of piano is less supported.

The role of the piano in the learning process

The piano or the digital or virtual keyboard instruments are basically tempered.[1] This means a sort of equal temperament, where the 12 semitones of the octave are exactly at the same distance from each other. Alexander John Ellis, a 19th-century English mathematician and linguist, developed a new system and unit of measurement for comparing the different temperaments and the pitches they could produce. Using the cent system, he transformed the 2:1 ratio of the octave into a linear scale of 1200 degrees, where intervals can be described by arithmetical differences. The semitone as the smallest pitch interval was defined as = 100 cents (the cent is the hundredth of a tempered semitone), while whole tones correspond to 200 cents. In fully equal tuning, all keys are of equal value

(Ferencziné, 2015).

Altered notes		C# D♭		D# E♭			F# G♭		G# A♭		A# B♭		
Natural notes	C ₄		D ₄		E ₄	F ₄		G ₄		A ₄		B ₄	C ₅
Hz	261.63	277.18	293.66	311.33	329.63	349.23	369.99	391.99	415.19	439.99	465.65	493.88	523.64
Cent	0	100	200	300	400	500	600	700	800	900	1000	1100	1200

Figure 1. The cent system

Related to the question of how to achieve pure singing and to the use of instruments it needs to be observed that *“it is well known that any kind of temperament [...] is alien to the pure intonation of the choir.”* One can use a piano to play a starting and a control note, as a kind of reference point, i.e., only playing notes that are the same (perhaps in the same octave). *“The part sung by the choir should never be struck on the piano. [...] The instrument is only for the purpose of constantly relating the sound to its starting point”* (Kardos, 1969: 29). The human singing voice is interpreted only in an acoustic context.

Properties of the acoustic overtone series

The human voice, the singing voice as a sound source, can be interpreted as an acoustic signal. When, for example, a string or a vocal cord vibrates, not only the fundamental is heard, but also its frequencies multiplied by whole numbers: its harmonic overtones. The frequency relationships are represented by the successive notes of the overtone series:

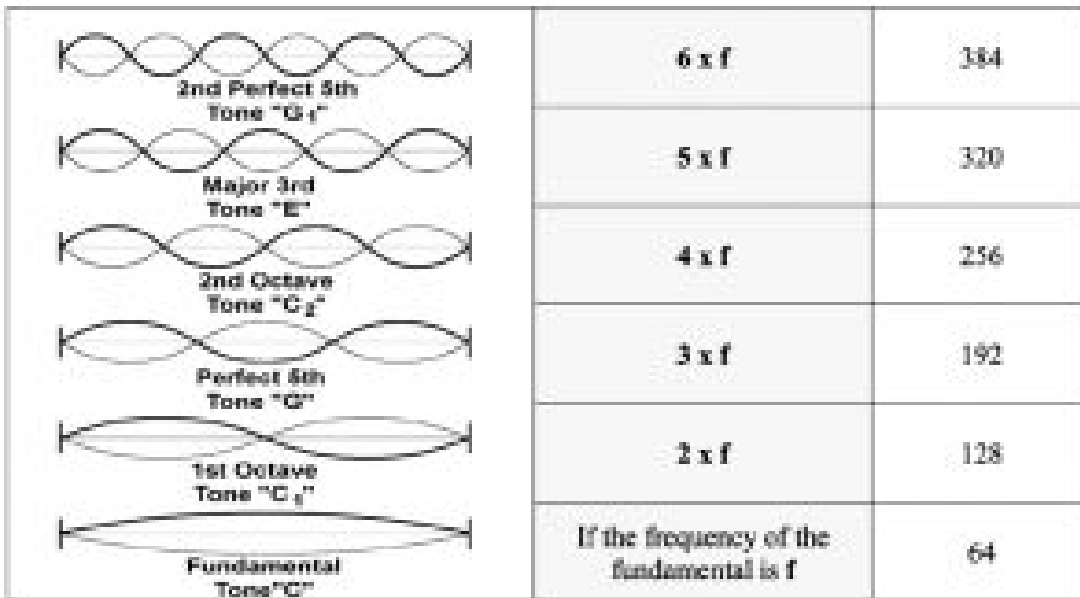


Figure 2. Overtone [2]

The following figure shows a series of overtones projected onto the great C/C₂ (overtone 7 and 11 are deeper than the notes used in the diatonic framework), with the frequency values and ratios associated with the notes below. Colours are used to denote octaves built upon each other.

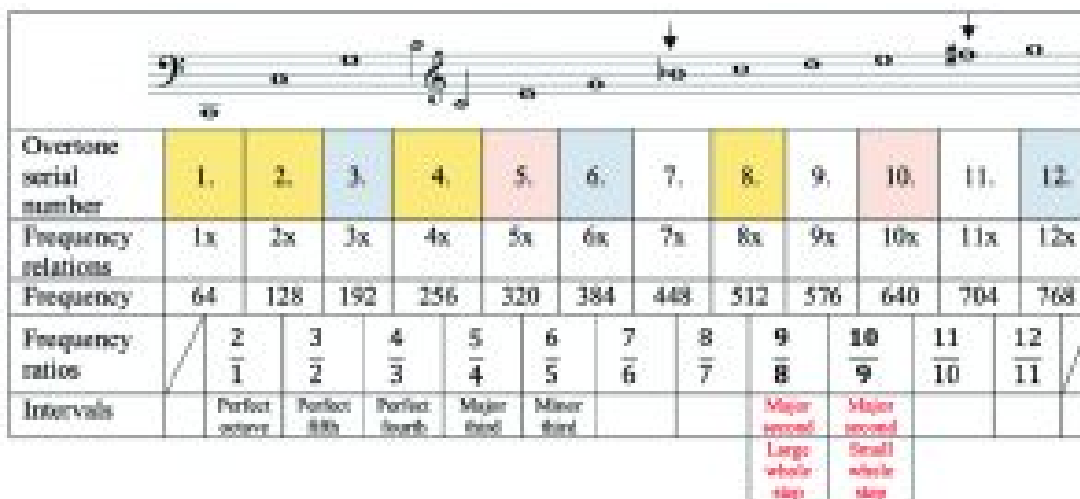


Figure 3. Frequencies and ratios

In the score of the overtone series, major seconds can be seen between overtones 8 and 10. Playing these on the piano means two whole tones of the same size. However, it is clear from the proportions below the intervals that the first interval, 9/8, is wider than the second one, which is 10/9. To

distinguish between the two types of major second, we use the terms $\frac{9}{8}$ "large whole step" and $\frac{10}{9}$ "small whole step." The frequency ratio of the two whole notes is $\frac{81}{80}$, corresponding to ≈ 22 cents.

Comparing the three types of whole tones (major second), the differences in size become apparent.



Figure 4. a-b. The three kinds of major seconds

The difference between large and small whole steps arising from the difference in acoustic frames is also clearly visible. In the major key, the seconds follow each other in the following order:

The same in natural minor scale:



The same in natural minor scale:



Figure 5. a. Major key; b. Natural minor key

On the basis of Figure 3, examining the thirds in the overtone series and the role and behaviour of the notes in the diatonic scale, we can depict the structure of the major triads as follows:

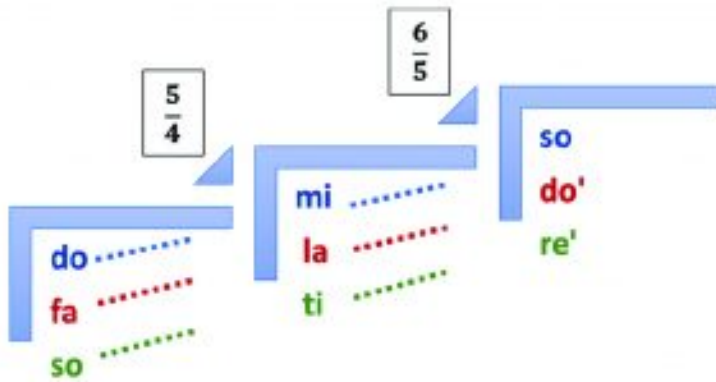


Figure 6. Major triads of the diatonic scale

All the chords have a pure major third and minor third structure. It is no coincidence that these have become the most stable and strongest triads of the major key, the major triads, the carriers of the main functions.

All but one of the minor chords of the diatonic system also sound clear. Only in the minor triad with a **re** root is the semitone forming the minor third paired with the $10/9$ small whole step, i.e., the minor third is narrower in this case by a ratio of $81/80$.

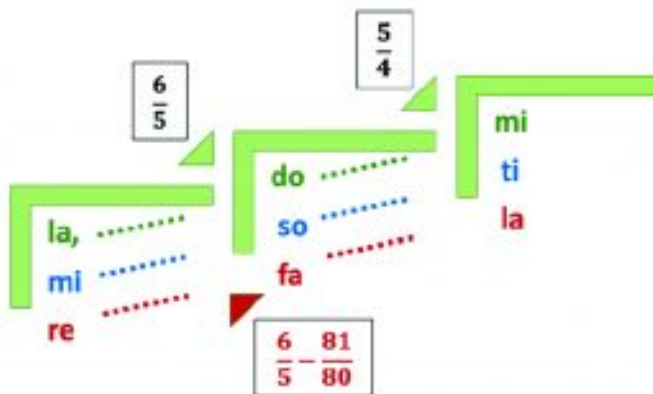


Figure 7. The minor triads of the diatonic scale

It is therefore clear that the **re** note is in a sensitive place, depending on its position and tonal location. The position of a note in a given tonality, its role, the stability of the pure intonation of different intervals and harmonies, can be developed through practice. A learning

process is effective if “constant” elements occur frequently among the ones to be learned. The more variables there are, the more unstable the memorisation of the turn to be learnt becomes, and the longer the process of deepening takes. Of the two types of solfa systems, absolute and relative ones (also known as “fixed do” and “movable do”), only one is capable of satisfying the above learning process, and that is the relative system.

The role of relative solfa in the development of clear intonation

The learning of tonal music pieces and the clear intonation of melodies and harmonies are ensured by relative solfa. The name of a melody’s notes, the distance between two notes with the same name, and their role in the tonality are constant. For example, in a major key, a **so-re-mi** turn always has a descending perfect fourth and an ascending major second, whatever the key we are in. With absolute solmization, however, the width of the intervals can vary, even with the same name.

so - re - mi

Relative solfa (movable do)



A musical staff in treble clef showing a sequence of notes for a 'so-re-mi' turn. The notes are G4, A4, B4, C5, B4, A4, G4. The staff is divided into five measures by vertical bar lines. The key signature changes from one sharp (F#) to one flat (Bb) to no sharps or flats (C) to one sharp (F#) to one flat (Bb). The notes are consistently placed on the same lines and spaces across the different keys, illustrating that the intervals between them remain constant regardless of the key.

Absolute solfa (fixed do)



A musical staff in treble clef showing a sequence of notes for a 'so-re-mi' turn. The notes are G4, A4, B4, C5, B4, A4, G4. The staff is divided into five measures by vertical bar lines. The key signature changes from one sharp (F#) to one flat (Bb) to no sharps or flats (C) to one sharp (F#) to one flat (Bb). The notes are placed on different lines and spaces across the different keys, illustrating that the intervals between them vary depending on the key.

Figure 8. Relative solfa – absolute solfa

In a tonal musical context, the most suitable method for achieving and practising pure intonation is therefore the use of relative solfa. Automatic use requires a lot of practice, and one of the tools of this is the use of hand signs. Due to their spatial positioning, they offer an excellent opportunity

to specify pitches in the right direction and to show the sensitivity of the notes.

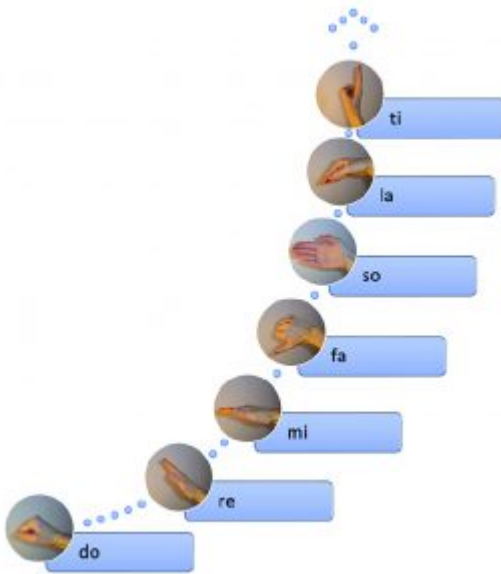


Figure 9. Hand-signs

Monophonic examples

Pure singing can only be achieved through the interaction of monophony and simultaneous voicing, the foundations of which must be laid in monophony. When pointing out the difference in width between the large whole step and small whole step, let us make others aware that in both major keys and natural minor keys, whole steps occur between the following degrees of the scale:

- 1-2.
- 4-5.
- 6-7.

From an intonation point of view, therefore, particular attention should be paid to intoning and sustaining the 2nd, 5th and 7th degrees high (Kardos, 2007):

do - fa - **so**; so, - do - **re**; mi - la - **ti**;
 la, - re - **mi**

where the **ascending second** in a fifth ambitus should be intoned high, or the **small whole step turns**:

do'-la-so; la-so-mi; re-do-la,;
so-mi-re
in which the **descending seconds** should be intoned high in a fourth ambitus.

Particular attention should be paid to the intonation of the two kinds of **re**. This can be practiced in a tune example as shown in the following chart:

<p>SO,</p> <p style="color: red;">high re ↑</p> <p style="color: red;">do - re - mi wide M2</p> <p>do-re-do do-re-mi-re-do do-re-mi-so-mi-re-do</p>	<p>LA,</p> <p style="color: red;">low re wide M2 ↓</p> <p style="color: red;">do - re - mi</p> <p>la,-mi-do la,-mi-do-re-do-la, la,-mi-do-re-mi-do-la, la,-do-re-mi-re-do-la,</p>
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Although we have used the term “**low re**” in the minor key, in practice we feel that the **do** and the **mi** are higher, more tense, and the **re** is deeper in comparison.

The two kinds of seconds can be illustrated by different colours in the following sheet music example:

The image shows two examples of musical notation. The top example is a three-staff score for 'Alleluia' with lyrics: 'Al-le-lu-ia. * G. F. Roderger'. The bottom example is a single staff in treble clef with the lyrics 'Al-le-lu-ia'. In both examples, intervals are circled: red circles highlight ascending seconds (do-re, re-mi, mi-fa) and blue circles highlight descending seconds (fa-mi, mi-re, re-do).

Figure 10. Alleluia[3]

Polyphonic examples

In his booklet *Let us Sing Correctly* (1941), Zoltán Kodály proceeds in the order of the acoustic overtone sequence,

voicing the octave and fifth intervals, and then in fourths to the sounding of the thirds.



Figure 11. Overtones

However, this sound order cannot be generalised to all choir types and age groups. The perfect fifth and the perfect octave can indeed be defined as the starting point for teaching pure intonation in male choirs, but for female and children's choirs, due to the relative scarcity of overtones resulting from the higher pitch of the fundamental, it is not advisable to start from these intervals. In the case of female and children's choirs, the two kinds of thirds are the most suitable intervals for the beginning, especially the **so-mi** and then the **mi-do** relation (Kardos, 1969). It is therefore no coincidence that the introduction of the tonic major and, almost in parallel, the minor triad is practised first, especially for mixed choirs. After practising the intervals that make up the triad, it is recommended to intone the perfect fourth below the root (lower **so**). This is followed by conscious practice of the seconds.

Examples:

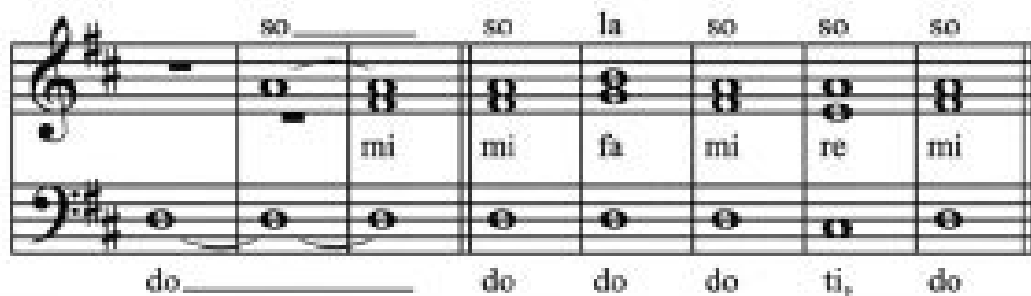


Figure 12. Major triads

The example above shows one possible way of combining the

three major triads illustrated above in three parts. After the root note is voiced as a solid, firm base, the soft fifth should be played, followed by an even more mellow third. The voice leading is then carried on in second steps, where attention must be paid to the high intonation of the notes **la** and **re**.

So-related high re:

An example shown using hand signs (*according to position in the chorus: soprano on the left, alto on the right*):

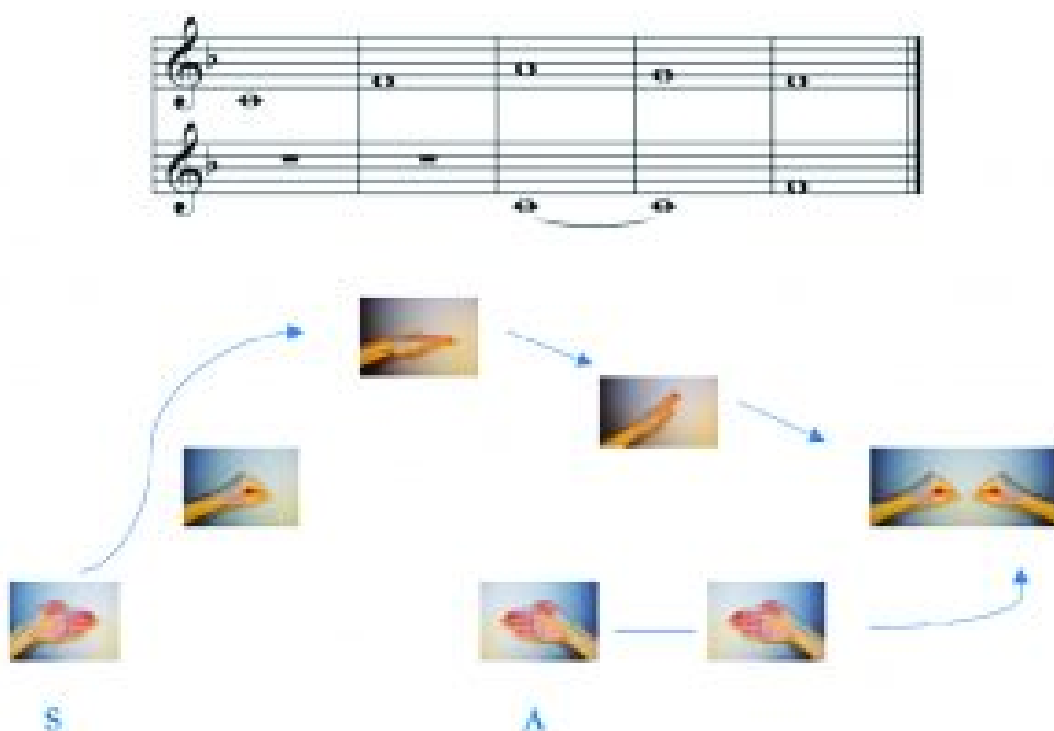


Figure 13. Hand-signs in major tonality

Schubert's *Mailied* clearly shows the behaviour of the **re** in major: above the lower **so**, the **re** is to be intoned high:



Figure 14. Schubert: Mailied [4]

La-related deep re:

An excellent way to practice is when the other part is matched to a sustained note. This offers a chance to relate intervals to a constantly fixed point. The exercise below demonstrates this in minor tonality, using hand signs:

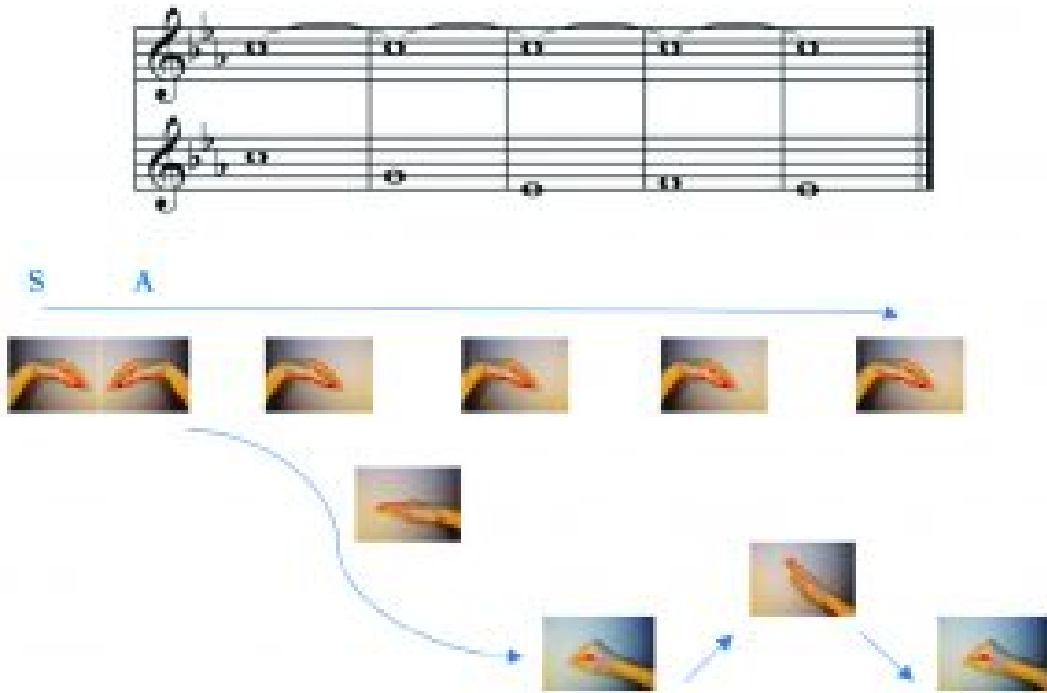


Figure 15. Hand-signs in minor tonality

In the case of a low **re** with a relation to **la**, the most important thing to pay attention to is the pitch of the following tone. E.g., **la**,-mi-re-**do** or **la**,-do-re-**mi**. That is, in the first example it is important to achieve a narrower second, in the second one, to achieve a wider second.

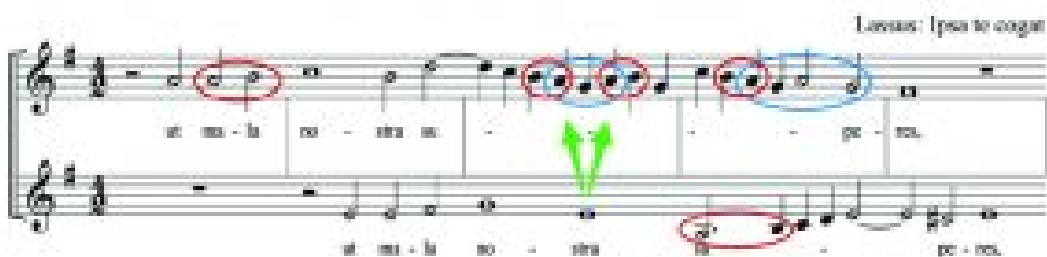


Figure 16. Lassus: Ipsa te cogat – excerpt

The role of the **re** in the tonality and the proximity of the

notes **la** or **so** and the effect of these latter sounds often render it difficult to make a theoretical decision. The frequent changes are influenced by the musical context, the leading of the part and harmonic thinking together.

Summary

For clear singing, it is best if the melodic elements can always be voiced with the same names and syllables, regardless of the key, according to their role in the tonality. The same distance, step or jump can only be given the same name in the relative solfa system. Within the framework of a given tonality, the intonation of the intervals becomes stable and well controllable (Ferencziné, 2015).



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[1] Andreas Werkmeister, a 17th-century organist, composer and theorist, who developed the technique of temperament, divided the pure octave into 12 equally spaced parts.

[2] Source: <https://www.soundsnap.com/blog/glossary/overtone/>

[3] Source: <https://gregobase.selapa.net/chant.php?id=1341>

[4] Source: [https://imslp.org/wiki/Mailied,_D.199_\(Schubert,_Franz\)](https://imslp.org/wiki/Mailied,_D.199_(Schubert,_Franz))