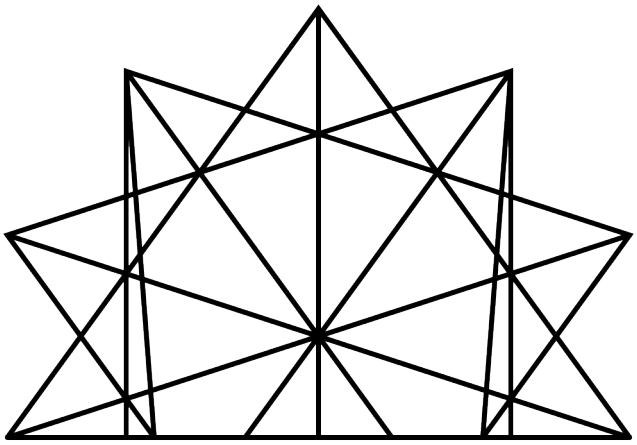
On String Tunings



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In 2002 I went to Egypt in order to observe the antiquities. While in Cairo I bought an oud (Arabic lute) for a decent price. The maker kindly showed me a couple of the preferred tunings of the instrument. It sparked my interest in further investigation. I drew up a list of the tunings of the guitar, oud and lute. Over time this list expanded as I added more instruments and extended the range from tenor (where the guitar and oud sit) to the soprano and bass extremes. The result is the list of one hundred and thirty-six tunings shown at the end of this article.

I make no claim that this list is comprehensive. Nevertheless, it is extensive enough to indicate the dominant patterns. Tunings of harps, keyboards and winds aren't included. In fact, I have not even shown all of the alternative guitar tunings—only a few of the most popular ones or ones that I have myself used. The list began as a simple inventory of the tunings of instruments that I play myself, but I couldn't resist including a wider survey. This inclusiveness inevitably leads to some reflection on string tunings in general. Consequently, I include various patterns that don't relate directly to specific instruments but also have importance for various reasons (mostly as key fragments of other patterns). The total number of patterns (136) is entirely arbitrary.

The tuning patterns are arranged from high pitch (soprano) at the beginning to bass at the end. Also, each pattern follows the order of the strings from high pitch to low pitch. In order to distinguish the range, I follow this convention: soprano c', middle c, tenor C, bass **C**, and sub-bass <u>**C**</u>. Additionally, the musical interval between the strings is marked. Here I use this convention: octave (:), major sixth (>), fifth (=), fourth (-), major third (*), minor third (+), second (^), minor second (\), and unison (.). Once in a while a tuning is re-entrant; that is, the pitch direction reverses. In order to indicate this situation (which happens occasionally in the list) I simply double the sign. The inventory number of the tuning is marked in bold. Normally I refer to a tuning by its inventory number, but also by its associated instrument.

Many of the tunings are exceedingly old. A case in point is **109**. It is here attached to the Indian vina and sarangi, but countless zithers of central Asia employ it. The case is enhanced when we remember that the pitch 'c' is variable in traditional cultures. The same tuning pattern can be given any pitch base. Thus we get the three-string bass tuning **129**. Shorter strings make versions at a higher pitch. I have included a few further examples in **10**, **25**, **42**, **57**, and **94**. All of this group have the same internal structure, appropriately defined as { - = }. This pattern forms the defining signature of the tuning, independent of any specific pitch.

The tuning pattern { - = } is evidently very closely related to { = - }. It too must be very old. In **111** it supports the Chinese ruan. The tunings **26**, **43**, and **96** provide

further examples of this pattern. These two patterns { - = } and { = - } arise out of the core tunings { = } and { - }. As one looks at further tunings it becomes evident that the use of fifths and fourths constitutes an important theme in string tunings.

The reader may notice that the list embodies tunings of three strings or more. I have not included two-string tunings. Actually, I made one exception in **73** (the Chinese erhu). Despite the absence from my list many two-stringed instruments exist, most of which are considered 'folk' instruments. Two-stringed instruments tend to be tuned either { = } or { - } and to a lesser extent { : } and { . }. The use of { * } or { + } is much rarer, although I'm convinced that practically every permutation must have been used by someone at some time, place and instrument. Nevertheless, a natural hierarchy of preference emerges in which tuning in fourths and fifths dominates. Patterns that use fourths with one major third form a large special group of tunings that include the modern guitar (**69**). I will spend more time with these important tunings later, but first let's look at some more alternatives that mix fifths and fourths. After that we will observe tunings in fifths alone, then fourths alone. This order will lead us reasonably to the center ground where the { * } is integrated into { - } and the occasional { = }.

A most natural and powerful extension of { - = } is the pattern { - - = } where in **56** it forms the tuning of the Indian sitar, sarod and vina (and probably others as well). It also makes an alternative for the Japanese biwa and doubtless other instruments across Eurasia. In the Indian instruments the top strings are augmented by drone strings as well as harp strings underneath the playing strings. These tunings are key centered or what we call *drone tunings*. In western terms **56** is a *C suspended fourth* chord emphasizing the key of C. The only modulation or alternative key in the sitar's tradition is the shift to F. This is done by tuning the G string down to F, resulting in tuning **58**. The move is reinforced by tuning every G in the drone strings down to F. This type of drone tuning { - = - } is also represented at lower pitch in **110** and higher pitch at **14** (where it forms a mandolin-violin 'C tuning').

Another potent extension of { - = } is the European hurdy gurdy tuning { = - = } at **45**. Again one can call it a 'C drone' tuning. At a higher pitch (**11**) it also forms the most popular alternative mandolin-violin tuning 'open G.' The theme of drone tuning is naturally extended if we allow the use of unisons and octaves. Then we get the Balkans tamboritsa (**99**) with pattern { . - = }. Such a tuning is very like the hurdy gurdy. Indeed, the hurdy gurdy also has a unison but it is rather marked as a double string of pitch 'gg.' Such double strings are called *courses*. The hurdy gurdy has only one course, but in the tamboritsa all four strings are doubles. Many of the instruments in this list have double strings, but I decided not to indicate the doubles unless there is an unusual situation—when the double strings are not tuned to a unison.

Perhaps the most important of the drone instruments is the Indian tamboura (**135**), with the re-entrant pattern { -- . : }. It forms an extension of the fourth by adding a unison and octave. Like the sitar, this instrument is also easily shifted into an open F

by tuning the **G** down to **F**. At a much higher pitch sits a related (but altogether simpler) extension of the fourth in the Russian balalaika (**18**), pattern { - . }.

The above group of patterns forms the middle ground of instruments that uses both fourths and fifths alone. However, it doesn't exhaust the field. Several unusual or eccentric tunings also employ these resources. For example, the Italian renaissance lira da braccio (**6**) gives the pattern { = = = - }, perhaps better classified with the group using fifths alone. The bottom course is an octave double. Far more eccentric is the lira da braccio tuning (**12**) with a re-entrant fourth and an octave. This tuning is quite unusual but pales in comparison with the renaissance lira da gamba or lirone (**15**). Here one sees *three* re-entrant fifths in a recurrent pattern. This is probably the most unusual tuning in the whole collection.

Now let us examine intruments that tune in fifths alone. The triple { = = } is represented by patterns **4**, **27**, **46**, **74** and **97**. These tunings form important subsets of further string tunings. I refer specifically to the string family of the European violin, dominated by the magnificent pattern { = = = }. Tuning **5** gives the modern violin and its corresponding four-course plucked alternative, the mandolin. The soprano tuning is also used on less popular instruments such as the banjolele (banjo-ukelele). A tuning in fifths excels for short-necked instruments in which the finger spread is maximal. Tuning **28** is placed for the alto range of the viola and mandola. At **75** sits the octave mandolin and the banjoline. Oddly enough there is no official standard bow for this pitch. The next bowed string in this group is the violoncello (and mandocello) at considerably lower pitch (**124**). The pattern is applied in the bass end by the European geig da braccio (**130**). Finally, I have also included further examples of { = = = } in tunings **13** and **98**.

A tuning in fifths is maximally extended in { = = = = }. By adding a fifth string to the viola we get the viola pomposa and mandora (**7**), in effect combining the viola and violin. Similarly, in **76**, the violoncello piccolo extends the intrument upward, filling the gap by the octave mandolin. Finally, the five-string 'cello (**125**) and the geig da braccio extend the range far into the bass end. Bass instruments tuned in fifths prove less practical due to the inordinate finger stretch. Consequently, larger mandolins have never been so widespread as smaller mandolins.

On long-necked instruments tuning in fourths is more practical and more widespread. The core pattern { - } expands to { - - }. At **131** sits the three string bass tuning. Further examples that form vital subsets of guitar and oud tunings appear at **22**, **36**, **49**, **91**, and **104**. This pattern makes a foundation for many widespread tunings.

The fourths pattern extends to the powerful { - - - }. At the very bottom of the range sits the double bass and electric bass (**136**). Somewhat higher in pitch comes **132** and **128** (the bass banjo). Exactly an octave higher than **132** in pitch one finds the seminal four-course oud tuning **51**. The f string is sometimes omitted from the instrument so that the sequence of fourths begins with the c. This gives us the tuning

the bottom end connected to a second peg-box. Now we have the arch-lute or theorbo (**41**). The 17th century ushered in a period of experimental tunings for the theorbo that hastened the demise of the intrument's popularity. Some of these tunings are quite eccentric and no longer express the pentad (for example **31** and **35**).

The oud, lute and guitar all have essentially the same active string-length. Hence it is understandable that their tunings can be interchanged and their tuning traditions interlock. The traditional lute tuning sits high in pitch—the oud and modern guitar around a fourth lower. One easy and popular modern way to shift the guitar into the renaissance pattern is to lower the G to F#, resulting in **72**. However, it has the disadvantage of expressing even more bias toward the sharp keys. Tuning **50** shows another placement of the renaissance pattern with a bias for the flat keys. By far the most appropriate way of placing the renaissance pattern on the guitar is tuning **93**.

The renaissance family of viols consists of bowed strings with tied-on frets like the lute. Naturally they also use the renaissance pattern { - - * - - }. The tenor viol sits an octave below the lute, expressing the high standard (**123**) and the low standard (**127**). The treble viol uses the balanced alternative placement **93** already recommended for the guitar. The bass viol (or viola da gamba) employs the lower octave of the C placement (**133**). The renaissance-baroque period showed considerable creativity in making new variants of stringed instruments. Some were quite experimental and played by few people. Nevertheless, the pattern { - - * - - } is quite prevalent.

Some tunings make variants of the renaissance pattern, closely related to it and preserving the underlying pentad harmony. The most widespread now, of course, is the modern guitar tuning { - * - - - }. The modern 12-string guitar tuning also supports the pentad. Another is the modern 'Drop D' guitar tuning **71**, pattern { - * - - =} that allows a fifth into the mix. Another is Dowland's seven-course lute tuning **40**, pattern { - - * - - = }. It also puts a fifth into the bass. Again we see it in the 17th century pandora (or bandora, a bass cittern) tuning **122**, pattern { - * - - ^ - }. Another cittern tuning, (**60**), also preserves the pentad. Further contemporary instruments of more rarity, such as the penorcon and orpharion, have up to nine courses. All express some extension or variation on the renaissance pattern. At the other end of the complexity scale, the small ukelele (**44**) still preserves the pentad harmony, though in a re-entrant manner. Missing the D, it forms a variant of the seminal core renaissance pattern shown at **21** and **120**. Yet another even more unusual echo that still preserves the pentad is the re-entrant South American charango (**3**). The pentad harmony has spawned many expressions.

So far I have not allowed a { + } into the tuning mix. When we do this a new type of tuning arises that we call *open tuning*. It makes a major chord (an essential subset of the pentad). A number of instruments have used this norm. The expansion of { + } into { + * } makes the essential subset, the major chord shown at **30**, **80** and **100**. The pattern further expands into the popular tuning { + * - }.

At **81** it sits on the machete. If the pattern is repeated one gets the tuning of the small English guitar, the Portuguese guitarillo and the requinte (**2**). But the pattern is most closely associated with the 5-string banjo. The reader may have noticed a profusion of banjo tunings in my list. Several factors contribute to this result. Firstly, the instrument comes in a number of sizes, resulting in a spread of its range. Secondly, it has a fifth string (shown in brackets) which is a high drone. The tuning of this extra string is variable (within a restricted range) and is normally adjusted to the particular key in which one wants to play. The whole milieu of the fifth string contributes to an attitude where it is permissible to shift the other strings as well. Thirdly, the instrument in its modern form is not very old (19th century); consequently, rigid tuning traditions have less hold upon it. Lastly, it has inspired several other new instruments (e.g. the banjeurine, banjolele, and banjoline) which encourage the mixing of tuning traditions. Nevertheless, the pattern { + * - } is dominant. Probably the most popular banjo tuning is 'open E' (**112**), followed by 'open G' (**82**) on smaller instruments. Between them sits 'open F' (**101**). Especially on the long-neck banjo one also sees 'open D' (**115**) and 'open C' (**126**). The bass banjo uses a tuning in fourths. Meanwhile, in another region of the pitch spectrum the smaller banjeurine also employs the pattern (**32**).

It is a simple matter to shift { + * - } into { + * = }, although the resulting harmony is no longer a simple major chord. It now becomes a subset of the hexad. We see it on the banjeurine (**33**). It also forms an alteration of 'open G' (**82**) to give what is called the 'old tuning' or the 'C tuning' (**83**). This tuning became popular after the Civil War. As we have seen in the bass banjo (**128**), the instrument is not restricted to tunings with a { + }. At **65** the 'open C' tuning uses { * - = }, an echo of the pentad tunings. More alternatives follow, but at least the bulk of the banjo tunings do have a { + } and make a major triad harmony.

Modern guitar open tunings preserve the spirit of banjo tunings by using { + * - } as an essential subset and making a major chord harmony. Two very popular examples are 'open G' (**84**) with the pattern { + * - = - } and 'open D' (**87**) with the pattern { - + * - = }. It is not surprising that alternative guitar tunings should follow banjo tunings, because the steel-string guitar evolved in the early 20th century in order to compete more effectively in volume with the (then more popular) banjo. The banjo itself had evolved to compete with horns and brass. The development of the electric guitar by mid-century has the last word on that account! Among historical instruments we see the chordal pattern in the 17th century six-course baryton (**47**) that makes a D major chord with pattern { * - + * - }. The baryton was alternatively tuned to a D minor chord (**48**) with pattern { + - * + - }. Sometimes the theorbo was similarly tuned, in which case it was called 'accord nouveau ou extraordinaire.' The high-pitched seven-string viola d'amore (**9**) was also tuned to a D minor chord in the pattern { - * + - = - }. Tunings using a minor chord harmony are less common than a major harmony and based upon the essential subset { * + - }.

Another instrument that preserves the pattern { + * - } but makes a more complex harmony than the major chord is the lyra viol (**102**) with the pattern { + * - - = }. Yet

more harmonically complex is the six-course theorbo tuning called 'the flat' (**31**) which gives the pattern { + * + - - }, a hexad subset. Even more eccentric is the nine-course theorbo tuning 'a cordes avalees' (**35**), a hexad subset with a bias for the flat keys. With the odd pattern { - * - = + ^ ^ - } it is surely one of the most eccentric tunings in my list.

Some instruments tune not to a major chord but rather to a suspended chord. We have already seen it in the sitar (**56**) that forms a C suspended fourth triad. Indeed, any placement of { - - } will give a suspension. However, my interest here lies in the use of a { ^ } to create such a chord. This group of tunings I call *suspension tunings* or *suspended triad tunings*. The essential defining subsets are { ^ - } and { - ^ }. They come together in the traditional Chinese p'ip'a tuning **118**, pattern { - ^ - }. The pattern { ^ - } makes the *suspended fourth* triad (sus4 in short), which can be seen in **29**, **59**, **77**, and **114**. A direct extension of it (and the p'ip'a) is the modern guitar 'dadgad tuning' (**86**), which makes a Dsus4 triad harmony with the pattern { - ^ - - = }. The oddly named 'mountain minor' banjo tuning (**78**) is also related—a Gsus4 with the pattern { ^ - - }. In a typically banjo manner, the bottom string is dropped a tone (**79**) to give { ^ - = }, a Csus2. The second subset { - ^ } gives a *suspended second* triad demonstrated on **19**, **34**, **85**, **103** and **117**, where it defines the Turkish tar. The final suspended triad tuning in my list is the re-entrant Turkish saz (**95**), a Gsus2. With the pattern { = ^^ } it perhaps belongs more to the following group.

I have left until last an eccentric group of re-entrant tunings associated with the renaissance cittern. At its core sits { ^ = }, the essential tetrad subset. The most common instance is the four-course instrument at **61** with the pattern { ^ = ^^ }. It makes a full *suspension tetrad* harmony. Sometimes the A is raised to B, making the pentad subset **60** with the pattern { ^ = ** }. Sometimes a fifth course is added to **61**, giving the pattern **62** { ^ = ^^ = } that preserves the tetrad harmony. I have indicated the doubles in **62** in order to show that it is not straightforward. Two courses have triples with a single on the bottom. Tunings **60** and **61** may also have triples. Tuning **63** shows a very eccentric cittern tuning on a six-course instrument. It forms a complete hexad—one of the most complex tunings in this whole collection.

Once in a while I come across a string tuning that doesn't seem to belong to any group. I have included one instance in the re-entrant Moroccan kuitra (**134**) that uses a major sixth in the pattern { - == > }. In spite of its peculiarity the harmony makes a suspension tetrad.

In the analysis of the material presented above, I have used as an organizing principle the pattern of the intervals involved and to a certain extent the associated family of instruments. However, the tunings can also be grouped in a more rigorous manner by the harmony produced. In turn the harmonies are conveniently grouped into dyads, triads, tetrads, pentads, hexads and so on.

A *dyad harmony* uses two adjacent members of the line of fifths (e.g. CG). Such harmonies make the grouping I have called *drone tunings*. In my list one finds a drone on F (**57**, **58** and **111**), on C (**14**, **43**, **45**, **99**, **109**, **110** and **135**), on G (**11**, **42**, **96** and **129**), on D (**10**, **26** and **94**), and on A (**18**, **25** and **73**).

A *triad harmony* uses three adjacent members of the line of fifths (e.g. FCG). Due to ambiguity in its root it has two functions: the *suspended fourth triad* (sus4) and the *suspended second triad* (sus2). The former can be found on C (**29**, **49**, **56** and **131**), on G (**77**, **78** and **104**), on D (**36**, **86** and **114**), on A (**59**, **91** and **118**), and on E (**22**). The latter can be found on F (**46** and **103**), on C (**34**, **79** and **97**), on G (**12**, **27**, **85** and **95**), and on D (**4**, **19**, **74** and **117**).

A *tetrad harmony* uses four adjacent members of the line of fifths (e.g. FCGD). It also forms a suspension harmony, but one in which the '2 and 4' are combined, written as a sus2,4 tetrad. In my chart we find it on F (**130**), on C (**13**, **51**, **98** and **132**), on G (**28**, **105**, **106** and **124**), and on D (**5**, **6**, **61**, **62**, **75**, **128**, **134** and **136**).

A *pentad harmony* uses five adjacent members of the line of fifths (e.g. CGDAE). This one is more complicated because certain subsets also gain significance. First consider the complete set. One can summarize the sample into C-E or better yet simply use C as reference. Then the harmony can be found on F (**37**, **38**, **39**, **40**, **52**, **53**, **54**, **90**, **107**, **108**, **125** and **127**), on C (**7**, **76**, **92**, **93**, **122** and **133**), on G (**23**, **24**, **68**, **69**, **70**, **71** and **123**), and on D (**72**). As an entirely unhistorical interpolation I have added Eb (**50**). The first significant subset omits the middle term (D in the sample, giving the harmony CGAE). It forms the core renaissance pattern with its ambiguity between C *major sixth* and A *minor seventh*. Again using C as the reference, the list gives the harmony on F (**89**), on C (**3**, **21**, **44**, **120** and **121**), and on G (**60** and **67**). Another subset of the pentad shows itself briefly on F (**102**), the F *major chord 'add nine'* with harmony FCGA. Far more significant subsets of the pentad lie in the *major* chord and *minor* chord. The major chord (M) is found on F (**17**, **100**, **101** and **116**), on C (**2**, **30**, **32**, **64**, **65** and **126**), on G (**16**, **80**, **81**, **82**, **84** and **113**), on D (**47**, **87** and **115**) and lastly on E (**112**). The minor chord (m) is found on D (**8**, **9**, **48** and **88**), on A (**20** and **119**), and on E (**66**).

The tunings up to the pentads cover most of the territory. However, some of the more unusual tunings push on to increasingly complex spaces. A *hexad harmony* uses six places, e.g. CGDAEB. If this pattern is referenced as C, then the complete set can be found on F (**55**), on C (**63**) and on A (**1**). Two 'thick' subsets can also be found. The hexad C to B (missing the D) makes **31**. The hexad Eb to D (missing the C) forms tuning **35**. The hexad also makes a chordal subset: the *major chord 'add four.'* It is found on C (**33**) and on G (**83**). Only one *heptad harmony* is found in the list at **41**, a sequence from Eb to A (missing the Bb). Finally, I have included but one *ogdoad harmony* (from C to C#) complete at **15**.

In an investigation of string tunings, it is appropriate to say a little bit about intonation, although I will keep it brief. Instruments can be placed into three camps with three very different capabilities or degrees of freedom. In the first camp come unfretted instruments such as the oud and the violoncello. Here one has complete freedom of intonation and it becomes difficult to speak about tuning 'systems' as such. In the second camp come instruments with tied-on moveable frets, such as the European lute and the Indian sitar. Here some sort of system can be operative, but it is fairly easily shifted into various possibilities. Thirdly come instruments that have fixed hammered-in frets like the guitar or banjo. Here some decision must be made beforehand and it becomes permanent or at least not easily changed. In this case the choice of a 'system' is inevitable. Of course, even in unfretted instruments the open strings must be tuned to some intonational norm. Whatever the choice, the fingers tend to reinforce the norm through habit and cultural influences.

For my purposes we need only consider five 'systems' or intonational norms. The first of them, the modern equal temperament, is a true *closed system* in which everything is tempered to a lesser or greater degree. It is now practically universal on all fixed-fret instruments, be it guitar, banjo or mandolin. It has also been adopted whole by various non-western cultures (e.g. China), or with minimal alteration—for example the Malian practice of adding a quarter-tone fret. Most western guitarists have little idea that this norm didn't gain prominence until the 19th century. Before that time a welter of alternatives lived in co-existence. Regional and even individual preferences held sway. Fixed frets on a short neck (like the mandolin) were adjusted toward equal temperament earlier than long-necked instruments like the oud. Here older norms held more sway.

The oud tuning **54** demonstrates the second (and very ancient) intonational norm. Tune the fourths (and fifths) pure and tune the major third sharp and dissonant. The method of tuning a line of fourths and fifths goes back to the oldest strata of Chinese culture. In the west some people still believe that the Greek Pythagoras discovered it, but it is certainly much older—likely the first Bronze Age. At any rate the earliest writings on intonation confirm a familiarity with this norm in China, India, and the Greek-Middle eastern sphere. It is pan-Eurasian and long-lived. We now give it the technical name *3-limit Just Intonation* or Pythagorean tuning. It is not a closed system like the equal temperament at all; rather, it presents an open-ended directive to tune a line of pure fourths and accept the consequences (i.e dissonant thirds).

The third ancient 'system' is also open-ended and has very old roots in the Indian sub-continent. Tune the fourths pure and in addition tune the major third pure. We moderns call it *5-limit Just Intonation* or the web of triadic harmonies. This consonant third comes from the harmonic series and places itself in the harp strings and drones of the sitar. It sits subliminally present in the tamboura drone. It inhabits many a traditional scale and melody. This norm, like the 3-limit, is also exceedingly ancient.

Moreover, we must not assume that the 3-limit and 5-limit norms compete with each other. The first is contained in the second. More significantly, any long

extension of the 3-limit line of fifths generates close analogs of 5-limit intervals. In other words, they interpenetrate each other. The Indian musician consciously chooses between the alternative third as an aspect of a pool of possibilities. Fortunately it has a lowest common denominator that the Hindus call a *sruti*, the west calls a *comma*. This is the very difference between the pure third and the sharp third. Every point on the scale is open to comma-shifted alternatives. The sitar player has moveable frets so that he can shift between the norms. Since a comma is only a very small interval, the fret need not be moved very far, but the mood of the scale is transformed. Nor is this knowledge confined to India. The medieval Arabic scientists recommended a line of seventeen fourths, thereby assuring themselves of the 5-limit norms. The Hindus use a line of twenty-two. The Chinese calculated that at the fifty-fourth place one almost gets closure; in other words, the octave consists of fifty-three commas. However, none of these cultures needed all fifty-three. Around half is more than enough. This pool of possibilities constitutes the nexus of ancient tuning culture, including medieval Europe.

The old way takes heed of the comma, but from the 15th to the 18th century a different norm (my fourth system) proved quite popular. Tune the third pure, but tune the fourths a little wide (quarter of a comma—a really small amount of tempering). When this is done the comma is sacrificed. It disappears and the scale resolves into enharmonics (sharps and flats). This makes it more practical than the old way for chordal harmony. The norm is called *meantone temperament*. This way is primarily a keyboard system closely tied to the historical harpsichord (which can be traced back to the 14th century British Isles). In the 15th century it conquered all of Europe. Although mainly tied to keyboards, the lute has moveable frets and some tuners (likely a minority) placed them appropriately for this norm. Some even tied on the enharmonic fret so that they have both C# and Db between C and D. This practice is quite feasible on the lute and guitar, at least lower down on the neck. The meantone temperament is also an open-ended line of fourths, but the slightest adjustment of it results in a closed system with a circle of thirty-one fourths. In other words, there are thirty-one enharmonics in the octave. Hence the meantone temperament is more of a real *system* like the modern equal temperament.

Most lutenists placed their frets not in accordance to any of the above approaches. They used my fifth 'system,' although this approach is even less of an actual fixed system than the previous four. It consists simply of some personal *compromise* between the 3-limit and meantone. Innumerable such compromises exist, and the player simply experimented until he found something to his own satisfaction. A few famous lutenists (e.g. Dowland) published their tunings, but the vast majority of players were content to keep it private. Consequently, different players had their own 'sound.' In addition, different regions of Europe had their own preferences or bias. There was no one 'correct' intonation. The modern equal temperament was one of these possibilities, an approach much closer to the 3-limit than the meantone. Gradually it won out over the others due to its practicality in regard to modulation.

Before the 19th century the practice of tied-on moveable frets was more prevalent than the fixed-fret approach. Consequently the varieties of intonation tended to coexist in an uneasy tolerance. However, with the advance of industrialization and mass standardization (and the influence of the king piano) the equal temperament took over for fretted instruments.

The situation is not so simple for unfretted instruments. Take for example the bowed strings (violin, violoncello). The open strings are traditionally tuned in pure fifths (system two), but players aim to place the fingers for the equal temperament. No doubt they achieve the ideal at times, but string players also tend to use much vibrato as a convenient mask for inaccuracies. Moreover, they stretch this a little and squeeze that a little in the name of expression. Thus we cannot say that they practice the equal tempered intonation, rather an expressive or *flexible intonation*. It is this very subtlety that makes a string quartet so pleasing and distinguishes one string group from another. Orchestras have perpetuated regional colours for similar reasons to the old lute culture. In a milieu where differences are inevitable, subtlety is valued.

This flexibility is also the case for other unfretted instruments. For the oud player the tuning in pure fourths is a firm reference system but complete freedom of finger placement insures that exotic intervals can be made even outside the ancient nexus. Indeed, the ancient nexus of comma shifts is already so intricate that it allows room for just about anything. Thus on very long-necked instruments such as the Turkish saz one sees very many 'microtonal' tied-on frets that don't necessarily conform *exactly* to the comma scale. Intonation becomes a function of cultural preferences.

The list:

1 a' – e' – b – f# - c# - G# bandurria, bandola, bandolin Hexad A-G#
2 g' + e' * c' – g + e * c English guitar, guitarillo, requinte CM
3 e' = a == e' * c' – g charango (5-course) CM6-Am7
4 e' = a = d Dsus2
5 e' = a = d = G violin, mandolin (4-course), banjolele (banjo-ukelele) Dsus2,4
6 e' = a = d = GG – dD lira da braccio Dsus2,4
7 e' = a = d = G = C viola pomposa, mandora (5-course) Pentad C-E
8 d' – a * f Dm
9 d' - a * f + d – A = D – **A** viola d'amore Dm
10 d' – a = d D drone
11 d' = g – d = G mandolin-violin 'open G' G drone
12 d' – a = d -- g : G lira da braccio Gsus2
13 d' = g = c = F Csus2,4
14 c' – g = c – G mandolin-violin 'C tuning' C drone
15 c' – g == d' – a == e' – b == f#' – c#' lira da gamba (lirone) Ogdoad C-C#
16 b * g – d GM
17 a * f – c FM
18 a – e . e balalaika A drone

19 a – e ^ d Dsus2
20 a – e * c Am
21 a – e * c – G CM6-Am7
22 a – e – B Esus4
23 a – e – B * G – D lute (5-course) 'high tuning' Pentad C-E
24 a – e – B * G – D – **A** lute (6-course) 'A or high tuning' Pentad C-E
25 a – e = A A drone
26 a = d – A D drone
27 a = d = G Gsus2
28 a = d = G = C viola, mandola (4-course) Gsus2,4
29 g ^ f – c Csus4
30 g + e * c CM
31 g + e * c + A – E – **B** theorbo (6-course) 'the flat' Hexad C-B, no D
32 g + e * c – G (c') banjeurine CM
33 g + e * c = F (c') banjeurine CM+4
34 g – d ^ c Csus2
35 g – d * Bb – F = **Bb** + **G** ^ **F** ^ **Eb** = **<u>Bb</u>** theorbo 'acordes avalees' Hexad Eb-D
36 g – d – A Dsus4
37 g – d – A * F – C lute, vihuela de mano (5-course) 'low tuning' Pentad F-A
38 g – d – A * F – C – **G** lute (6-course) 'G or low tuning,' orpharion Pentad F-A
39 g – dd – AA * Ff – Cc – **GG** lute
40 g – d – A * F – C – **G** = **C** (or –**D**) Dowland's 7-course lute Pentad F-A
41 g – d – A * F – C – **G** ^ **F** ^ **E(b) D** theorbo Heptad Eb-A (no Bb)
42 g – d = G G drone
43 g = c – G C drone
44 g = c ** e -- a ukelele CM6-Am7
45 gg = c – G = C hurdy gurdy C drone
46 g = c = F Fsus2
47 f# * d – A + F# * D – **A** (plus drones) baryton DM
48 f + d – A * F + D – **A** (plus drones) baryton Dm
49 f – c – G Csus4
50 f – c – G * Eb – **Bb** – **F** renaissance pattern for flat keys Pentad Eb-G
51 f – c – G – D oud (4-course), biwa Csus2,4
52 f – c – G – D – **A** oud (5-course) Pentad F-A
53 f – c – G – D – **A** ^ **G** oud (6-course) Pentad F-A
54 f – c – G – D – **A** * **F** oud (6-course), Cairo tuning Pentad F-A
55 f – c – G – D – **A** – **E** oud (6-course) Hexad F-E
56 f – c – G = C (plus drones) sitar, sarod, vina, biwa Csus4
57 f – c – F F drone
58 f – c = F – C (plus drones) sitar F drone
59 e ^ d – A Asus4
60 e ^ d = G ** B cittern (4-course) GM6-Em7
61 e ^ d = G ^^ A cittern (4-course) Dsus2,4
62 ee ^ dd = Ggg ^^ Aaa = D cittern Dsus2,4
63 e ^ d = G ** B \\ c + A cittern (6-course) Hexad C-B
64 e * c – G CM

65 e * c – G = C (g) banjo 'open C' CM
66 e – B * G Em
67 e – B * G – D lute, vihuela, (4-course) 'high tuning' GM6-Em7
68 e – B * G – D – **A** Spanish guitar, vihuela (5-course) Pentad G-B
69 e – B * G – D – **A** – **E** modern guitar Pentad G-B
70 ee – BB * dG – AD – AA – EE 12-string guitar (6-course) Pentad G-B
71 e – B * G – D – **A** = **D** guitar 'drop D' tuning Pentad G-B
72 e – B – F# * D – **A** – **E** guitar renaissance tuning Pentad D-F#
73 e = A erhu A drone
74 e = A = D Dsus2
75 e = A = D = **G** octave mandolin (4-course), banjoline Dsus2,4
76 e = A = D = **G** = **C** violoncello piccolo Pentad C-E
77 d ^ c – G Gsus4
78 d ^ c – G – D (g) banjo 'mountain minor' Gsus4
79 d ^ c – G = C (g) banjo Csus2
80 d + B * G GM
81 d + B * G – D machete GM
82 d + B * G – D (g) banjo 'open G' GM
83 d + B * G = C (g) banjo 'old tuning' or 'C tuning' GM+4
84 d + B * G – D = **G** – **D** guitar 'open G' GM
85 d – A ^ G Gsus2
86 d – A ^ G – D – **A** = **D** guitar 'dadgad' tuning Dsus4
87 d – A + F# * D – **A** = **D** guitar 'open D' DM
88 d – A * F Dm
89 d – A * F – C lute, early guitars (4-course) 'low tuning' FM6-Dm7
90 d – A * F – C – **G** lute (5-course) 'low tuning' Pentad F-A
91 d – A – E Asus4
92 d – A – E * C – **G** Pentad C-E
93 d – A – E * C – **G** – **D** treble viol, renaissance guitar Pentad C-E
94 d – A = D D drone
95 d = G ^^ A saz (3-course) Gsus2
96 d = G – D D drone
97 d = G = C Csus2
98 d = G = C = F Csus2,4
99 c . c – G = C tamboritsa (4-course) C drone
100 c + A * F FM
101 c + A * F – C (f) banjo 'open F' FM
102 c + A * F – C – **G** = **C** lyra viol FM+9
103 c – G ^ F Fsus2
104 c – G – D Gsus4
105 c – G – D – **A** oud (4-course) Gsus2,4
106 c – G – D – **A** ^ **G** oud (5-course) Gsus2,4
107 c – G – D – **A** * **F** oud (5-course) Pentad F-A
108 c – G – D – **A** – **E** oud (5-course) Pentad C-E
109 c – G = C vina, sarangi C drone
110 c – G = C – **G** C drone

111 c = F – C ruan F drone
112 B + G# * E – **B** (e) banjo 'open E' EM
113 B * G – D GM
114 A ^ G – D Dsus4
115 A + F# * D – **A** (d) banjo 'open D' DM
116 A * F – C FM
117 **AA** – **EE** ^ **DD** tar (3-course) Dsus2
118 A – E ^ D – **A** p'ip'a Asus4
119 A – E * C Am
120 A – E * C – **G** CM6-Am7
121 A – E * C – **G** (d) long-neck banjo CM6-Am7
122 A – E * C – **G** – **D** ^ **C** – **G** pandora or bandora Pentad C-E
123 A – E – **B** * **G** – **D** – **A** tenor viol 'high tuning' Pentad G-B
124 A = D = **G** = **C** violoncello, mandocello (4-course) G sus2,4
125 A = D = **G** = **C** = **F** 5-course violoncello, geig da braccio Pentad F-A
126 G + E * C – G (c) long-neck banjo 'open C' CM
127 G – D – **A** * **F** – **C** – **G** tenor viol 'low tuning' Pentad F-A
128 G – D – **A** – **E** bass banjo Dsus2,4
129 G – D = **G** 3-string bass G drone
130 G = C = **F** = **Bb** geig da braccio (4-string) Fsus2,4
131 F – C – **G** 3-string bass Csus4
132 F – C – **G** – **D** Csus2,4
133 D – **A** – **E** * **C** – **G** – **D** bass viol (viola da gamba) Pentad C-E
134 D – **A** == E > **G** kuitra (4-course) Dsus2,4
135 **G** -- C . C : **C** tamboura C drone
136 **G** – **D** – **A** – **E** double bass, electric bass Dsus2,4

Note: Due to the vagaries of this computer program, two versions of the 'dash' (musical fourth) appear. In the text one sees (-), a short thick dash, but in the table the program automatically changed them to a long thin version. I have no idea why, and in tuning **1** and **9** it managed to mix them! Both shapes mean the same thing.

--April, 2006, Amsterdam

The Principal Lute Tunings

European Lute	Modern Guitar		Arabic Lute		European Lute			
D Tuning 'Tenor'	Quasi-Renaissance tuning	Standard tuning	The 'old' Tuning	The classic tuning	G Tuning 'low alto'	Extended G Tuning (Dowland)	A Tuning 'high alto'	Extended A Tuning
d′	e′	e′	f′	f′	g′	g′	a′	a′
a	b	b	c′	c′	d′	d′	e′	e′
e	f#	g	g	g	a	a	b	b
c	d	d	d	d	f	f	g	g
G	A	A	A	A	c	c	d	d
D	E	E	E	F	G	G	A	A
						D		E

harmony

C G D A E	D A E B F#	G D A E B	F C G D A E	F C G D A	F C G D A	F C G D A	G D A E B	G D A E B

-drawn by Siemen Terpstra