"Helix Song" Musical Instrument
Harmonic, II-Limit
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Helix Song
(in the harmonic genus
where Diaphonic Cycles of 12 & 17 tones
intersect on the frequency ratio 10/7)
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### 2 Forms of the Helix Smg E.W. 4-14-98

<table>
<thead>
<tr>
<th>V1</th>
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<th>4/3</th>
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Tunings and Neutral 3rds

Two main classifications of bagpipes throughout Europe differentiated the loud pipes, whose air was supplied by the player's mouth, and the soft pipes which were entirely bellows-filled. The first of these, by far the older of the two, was found in fourteenth-century Ireland where it was called the war pipe.

The other bagpipe, bellows-filled, was intended primarily for indoor entertainment, calling for gentle and sweet sounds. Contrary to the louder type, the bellows-filled instrument often had fingerholes designed to approximate equally tempered intonations, which ultimately resulted in a more or less chromatic instrument. Examples of the chromatic bagpipe were the famous *musettes* of France, the Northumbrian pipes of England, Union pipes, and other pipes of various European localities.

Originally, neutral intonations were probably characteristic of all loud mouth blown bagpipes, including among them the early half long or gathering pipes of England; the *cornemuse* made famous by the players of Poitou, France; the *tabor* of Brittany; the war pipe of Ireland and the Highland pipe of Scotland. The intonations of some of these instruments, although having been primarily endowed with neutral traits, may have been partially changed throughout the centuries to conform to the later practices of tones and semitones. Nonetheless, this was accomplished by different principles of construction related to fingerhole placement and the diameters of such holes.

Actually, bagpipes, *scheriari*, *rauschkopsfen*, *cromornes* and *rankets* were replaced during the Baroque Period (ca. 1600) by other woodwind instruments which did not have their vibrating reeds within a wind cap. Pre-Baroque instruments, which had the wind cap, could neither be humidified for bad intonations nor could they be overblown (58: 351, 352). Despite these disadvantages, however, one may still witness the use of the wind cap in certain rural sections of France (25:195).

Anthony Baines, in his book on bagpipes, has provided us with a wealth of information. Speaking of the bagpipes in general, he pointed out that neutral 3rds were handed down in the making of the pipes. He also mentioned the equi-distant placement of fingerholes which were tuned with wax fillings.

Additional corrections sometimes followed the above procedures to make the intonation of the pipe's instrument conform to the existing tuning standards of his locality (2: 24). Tunings could even be different in each area.

The interval of the 3rd as measured from the fundamental tone is frequently neither major nor minor. This is the neutral tuning that was usually encountered in the lowest register of the majority of earlier woodwind instruments without metal keys. This is also the case with numerous bagpipes.

Although some woodwind instrumentalists employed the use of cross-fingerings to raise the pitch of the neutral 3rd, this practice was not encountered generally among bagpipers, who contributed to the presence of neutral intervals in folk music.

Woodwind instruments without keys either had the characteristic neutral 3rd, or this interval could at times be raised to a major 3rd by widening the fifth and sixth holes (3:214). Bagpipe tunings did not seem to offend the ears of too many people because, as stated by Mersenne during the seventeenth century, Europeans employed the bagpipe as the main instrument for weddings, dances and other diversions. In Bulgaria it has been said that, “a wedding without a bagpipe is like a funeral” (2: 85).

II. Scotland

From the standpoint of intonation we should focus particular attention on the Scottish Highland bagpipe, an instrument which has aroused the curiosity of many musicologists and laymen alike. The intervallic ratios of this bagpipe may have been introduced through a Celtic or a Roman source.  

James I of Scotland (1394-1437), who had a fine reputation as a performer, seems to have been responsible for the popularization of the bagpipe in his domain. It was from this period that the “pipes” were popular in Scotland as well as in Ireland and Wales. In Irish poetry, however, the bagpipe was mentioned five hundred years earlier (11:324).

In all probability it was at the time of James I or the years directly following that the bagpipe was accepted as the Scottish national instrument, having the same tunings then as at the beginning of the twentieth century. Because of its intense national representation, the Scotch Highland bagpipe has maintained its rigid neutral tunings with great persistence.

One of the most popular of bagpipe tunings was cited by Alexander Ellis in his description of a chanter by MacDonald. Considering that this instrument had a range of a major 9th - g to a" - two scales were possible. The first of these, g to g", was associated with the Mixolydian (Ionian, Lydian) modal characteristics (20:185).

<table>
<thead>
<tr>
<th>Intervals in Cents:</th>
<th>0</th>
<th>191</th>
<th>388</th>
<th>532</th>
<th>686</th>
<th>894</th>
<th>1044</th>
<th>1200</th>
<th>1391</th>
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<td>191</td>
<td>197</td>
<td>144</td>
<td>154</td>
<td>208</td>
<td>150</td>
<td>156</td>
<td>191</td>
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1 Scotland's history may be traced as far back as the arrival of the Celtic tribes. In Caledonia (332 B.C), the Celts were known as the Picts.

Gnaeus Julius Agricola (ca. A.D. 78-85), a Roman general, won victories over the Ordovices in Wales and over the Caledonians of Scotland. His invasions extended as far as the Grampian Mountains of Scotland, where musical instruments may have been introduced.

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2 See page 37 regarding tenth-century Irish poetry.
Scotland

In the preceding example neutral tones are most conspicuous: four of these intervals occur: 144, 154, 150 and 156 Cents.

Aesthetically, there is no appreciation here for the perfect 4th or 5th of Western culture. These kinds of measurements, which suggest a modal origin stemming from medieval times or earlier, could not have been conceived from Pythagorean ratios. Instead they must have resulted from equi-stepped tendencies introduced either by the Romans, Moors (at the time of the invasion of Spain), numerous ecclesiastics (through Gregorian chant) or by returning Crusaders (ca. 1200-1300). The church was known to have employed the bagpipe; however, the Crusaders brought back to Europe many examples of the Eastern musical culture, including the characteristic neutral tunings (30:12).

It is also possible that the drone for the bagpipe was brought back at this time, since the earliest European representations of such affixtures were found after 1300. The neutral tunings perhaps brought back during this period were also common to Eastern bagpipes.\(^3\)

\(^2\) Neutral tunings of Gregorian chant were derived from ancient Greek and Hebrew music (71:30). Abraham Z. Idelsohn, in his book Jewish Music (New York: Holt, 1929), p. 47, stated that the third Gregorian mode was identical to the Dorian mode of ancient Greece, and moreover, that it emanated from the Mode of the Pentatesuch sung in the Near East. Intervals of approximately 150 Cents values (5/tones) occurred four times in the octave structure, p. 25.

The Reverend Dom Dominique Jobner, in his volume A New School of Gregorian Chant (New York: Pustet, 1925), p. 32, stated that the quillsima, or ornamentation, usually included neutral tunings between the tones d-f, and between a-c. In his book Gregorian Chant (Bloomington and London: Indiana University Press, 1958), pp. 114-15, Will Apel mentions the writings of C. Vixell: Das Quillisme (Greg. Rundschau, Vols. IV and V, several installments). Vixell concluded that the quillisme denoted an ascending portamento between a minor or a major 3rd touching upon both chromatic and enharmonic pitches. Enharmonicism of the Middle Ages was synonymous to our present practice of microtones. European singers apparently performed whole tones and semitones with variable intervals and measurements (58:269).


Deriving originally from chants of the Synagogue and the early Christian period, Gregorian chant had many later contributors: those who preceded Gregory I; ecclesiastics who possibly provided Antiphons during Gregory's time; the Roman abbots Catolemus, Mauriarius, and Vehemans, perhaps (fifty years after Gregory); and most important, those writers who formed the standard repertory in France (750-850). One particular source, the MS Codex St. Gall 359, is extremely reliable. Willi Apel provided the above information in his book Gregorian Chant, pp. 35 and 82.

\(^3\) Included in Western European bagpipe performances were the decorative "shakes" originally supposed to have been used in imitation of similar Near Eastern or Andalucian musical practices (62:62).

Scotland

The second octave series of notes available on MacDonald's chanter, range a' to a'' (20:185), has been associated with the Aeolian, Dorian and Mixolydian modes.

\[
\begin{array}{cccccccc}
 & a' & b' & c' & d' & e' & f' & g' & a'' \\
\text{Sums in Cents:} & 0 & 197 & 341 & 495 & 703 & 853 & 1009 & 1200 \\
\text{Intervals in Cents:} & 197 & 144 & 154 & 208 & 150 & 156 & 191 \\
\end{array}
\]

Commencing the bagpipe scale on the second degree, a', these same neutral tones of MacDonald's chanter automatically become the 3rd and the 6th of the scale, respectively. The maintenance of these tunings over a period of centuries can easily be explained, because the Scottish Highlands consist of mountainous regions. In such rustic and sometimes isolated settings, it is not at all difficult for neutral tunings to remain unchanged, in both the instrumental and vocal musical tradition.

Every Scottish Highland bagpipe has slightly different intervallic values. Readings from MacDonald's chanter include neutral steps plus whole-tone steps ranging from 191 to 208 Cents. Other chanter tunes from Scotland which have been examined reveal the influence of equal temperament, despite the presence of authentic neutral notes.

\[
\begin{array}{cccccccc}
 & g & a' & b' & c' & d' & e' & f' & g'' \\
\text{Sums in Cents:} & 0 & 204 & 397 & 546 & 703 & 902 & 1050 & 1206 & 1401 \\
\text{Intervals in Cents:} & 204 & 193 & 149 & 157 & 199 & 148 & 156 & 198 \\
\end{array}
\]

Starting the scale with the note a':

\[
\begin{array}{cccccccc}
 & a' & b' & c' & d' & e' & f' & g' & a'' \\
\text{Sums in Cents:} & 0 & 193 & 342 & 499 & 698 & 846 & 1002 & 1209 \\
\text{Intervals in Cents:} & 193 & 149 & 157 & 199 & 148 & 156 & 198 \\
\end{array}
\]

In the above both readings and those of MacDonald's chanter (p. 37), one can readily see the amount of latitude which is always present in equi-stepped structures.

The different-sized tones seem to vary as much on Scotch bagpipes as they do on Thai raiants and East African Chopi xylophones; all three of these instruments are famous exponents of neutral tunings.

Perhaps the tuning variances of the tones a', b', d', e' and g' of the Highland bagpipe have been somewhat affected through the centuries by Pythagorean ratios, as well as by the numerous meantone tuning systems found on the
A Tuning For The Highland Pipes
based on the harmonics of the drones
©1997 by McDonald Wilson

Harmonics:
Drones 1 & 2, on A

Drone 3, on E

Highland Bagpipe

Harmonic Series

* This is a theoretical scale. For actual measurements refer to Theodore Podnos(?) p. 37-39.

The 19/16 (at B-D and E-G) compares epimorically with 32/27; \( \frac{19}{16} \times \frac{27}{32} = \frac{513}{512} \approx 1.0028128 \).
P39/3 another Scottish Chanter

32 36 39 48 52 57 64
A B C# D E F# G

\[
\begin{align*}
32 & \times 3 = 96 \\
32 & + 64 = 96
\end{align*}
\]

\[
\begin{align*}
\frac{8}{6} & \times \frac{13}{13} = 117 \\
\frac{8}{6} & + \frac{13}{13} = 33
\end{align*}
\]

embraced in Fibonacci rapport