

All Scales of the Western World

von
Hasso B. Manthey
im Januar 2009

| | |
|---------------------------------------------------------------------------|---|
| 1. Grundlagen..... | 2 |
| 2. Tonleitern des Westens | 2 |
| 3. Wie viele Tonleitern sind theoretisch möglich? | 3 |
| 4. Zur Auswahl "brauchbarer" Leitern aus den 462 möglichen..... | 4 |
| a) Alle Töne aus der Reihe C-D-E-F-G-A-H-C´ kommen im Prinzip vor | 4 |
| b) Keine Tonleiter beginnt mit zwei kleinen Sekunden..... | 4 |
| c) Keine Tonleiter endet mit zwei kleinen Sekunden. | 4 |
| d) Keine Tonleiter schichtet mehr als zwei kleine Sekunden innerhalb..... | 4 |
| e) Keine septatonische Tonleiter beginnt mit einer Terz | 4 |
| 5. Zur Untersuchung der 462 möglichen 7-Ton-Leitern | 5 |
| 6. Liste aller "brauchbaren" septatonischen Leitern | 6 |
| 7. Liste aller mathematisch möglichen septatonischen Leitern | 9 |

Es wird untersucht, welche Tonleitern es nach den Gesetzen der Mathematik im Tonsystem der westlichen Welt überhaupt geben kann und welche davon „brauchbar“ sind.

1. Grundlagen

Alle Kulturvölker der Welt kennen in der Musik die Oktave, d. h., dass sie einen Ton und einen Ton mit doppelter Frequenz als „gleich“ empfinden. Spielt man z.B. Töne von 440 Hz und 880 Hz nacheinander, wird der zweite Ton als „gleicher“ Ton empfunden, nur „höher“. Wir sagen, dass beide Frequenzen den Ton A darstellen und nennen den ersten z.B. a1 und den zweiten a2.

Innerhalb der Oktave werden in allen Musikkulturen gewisse Tonabstände und Töne ausgewählt, mit denen man musiziert. Wenn man zusammen singt oder musiziert, müssen sich die Beteiligten an gewisse Töne und Tonabstände halten, weil es sonst „schräg“ klingt. Wenn z.B. einer im Chor 440 Hz singt und der Nebenmann 443 Hz, dann wird das zumindest bei uns als „dissonant“ empfunden. Welche Töne „dissonant“ oder „konsonant“ sind, ist jedoch kultur- und zeitabhängig. Töne der indischen oder der türkischen Musik galten bis vor wenigen Jahrzehnten bei uns als absolut schrill. Heute werden sie in Diskotheken gespielt.

Alle Musik-Kulturen der Welt teilen deshalb die Oktave in Normtöne ein. Als grösste Einteilung sind fünf Töne bekannt (Pentatonik), als feinste Einteilung sind mir aus Indien 22 Töne bekannt.

2. Tonleitern des Westens

Die Oktave wird in der europäischen Musik in 12 Töne unterteilt.

| | | | | | | | | | | | | |
|---|-----|---|-----|---|---|-----|---|-----|----|-----|----|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| c | cis | d | dis | e | f | fis | g | gis | a | ais | h | c' |

In musikalischen Werken werden in der Regel jedoch nicht alle 12 Töne benutzt, sondern aus den 12 Tönen werden vielmehr zwischen fünf und neun Töne ausgewählt, die Grundlage der Komposition sind und dem musikalischen Werk einen eigenen Charakter verleihen. Diese ausgewählten Töne nennt man eine „Tonleiter“. In der Regel werden in der westlichen Welt, insbesondere für klassische Musik sieben Töne aus der Oktave für eine Tonleiter ausgewählt.

Ich untersuche im Folgenden, welche Sieben-Ton-Leitern bei maximal 12 Halbtönen in der Oktave mathematisch möglich sind und welche davon musikalisch "brauchbar" sind.

3. Wie viele Tonleitern sind theoretisch möglich?

Der erste Ton, z.B. „c“, stehe fest. Dann stehen zur Bildung einer Tonleiter noch 11 Töne zur Verfügung: cis, d, dis, e, f, fis, g, gis, a, ais und h.

Wählt man z.B. d als zweiten Ton, dann gibt es weitere 10 Möglichkeiten für den dritten Ton, usw. Mathematisch berechnet man die Anzahl der möglichen Wahlen von n Tönen aus 11 möglichen mit der Formel:

$$n \text{ aus } 11 = \frac{11!}{n!(11-n)!}$$

Die Berechnung ergibt:

| Töne in der Leiter | Anzahl verschiedener Leitern |
|--------------------|----------------------------------------------|
| 12 | 1 bei 12 aus 12 gibt es nur eine Möglichkeit |
| 11 | 11 man kann jeweils nur einen Ton auslassen |
| 10 | 55 man kann jeweils zwei Töne auslassen |
| 9 | 165 zu c werden acht weitere Töne gewählt |
| 8 | 330 zu c werden sieben weitere Töne gewählt |
| 7 | 462 zu c werden sechs weitere Töne gewählt |
| 6 | 462 zu c werden fünf weitere Töne gewählt |
| 5 | 330 zu c werden vier weitere Töne gewählt |
| 4 | 165 zu c werden drei weitere Töne gewählt |
| 3 | 55 zu c werden zwei weitere Töne gewählt |
| 2 | 11 zu c wird nur ein weiterer Ton gewählt |

Die größte Anzahl an verschiedenen Tonleitern gibt es bei 6 oder 7 Tönen! „Naturvölker“ und der Blues kommen mit 5 Tönen aus (Pentatonik). Die europäische „Kunstmusik“ arbeitet in der Regel mit 7-Ton-Leitern.

4. Zur Auswahl "brauchbarer" Leitern aus den 462 möglichen

Tatsächlich finden in der Musik nicht alle mathematischen möglichen Tonleitern auch Verwendung. Die Untersuchung von 35 aus der Literatur bekannten 7-Ton-Leitern lässt folgende Gemeinsamkeiten in den Tonleitern der Völker erkennen:

a) Alle Töne aus der Reihe C-D-E-F-G-A-H-C´ kommen im Prinzip vor

Es kann Des oder Dis an Stelle von D vorkommen, aber es wird kein "Normton" ausgelassen. Eine Tonleiter wie c-cis-d-dis-e-f-fis-c, die mathematisch möglich ist, die aber kein a und kein h enthält, wird von den Völkern nicht benutzt. In den Tonleitern werden Sekunden, Terzen, Sexten und Septimen erhöht oder vermindert, aber die reine Quinte und die reine Quarte sind sehr beliebt. Die reine Quinte (C-G) ist in 75% aller Leitern enthalten. Ebenso häufig kommt die reine Quarte (C-F) vor.

b) Keine Tonleiter beginnt mit zwei kleinen Sekunden.

Unter den bekannten Tonleitern gibt es C-D oder C-Des, auch mal C-Dis, aber nie die Anhäufung C-Des-D. Beginnt eine Tonleiter mit einer kleinen Sekunde, so folgt immer eine große Sekunde, also C-Des-Es.

c) Keine Tonleiter endet mit zwei kleinen Sekunden.

Es gibt H-c oder B-c, aber nicht B-H-c. (Ausnahme: „Enigmatic“).

d) Keine Tonleiter schichtet mehr als zwei kleine Sekunden innerhalb.

Ausschließlich im sogenannten „Oriental Major oder Minor“ gibt es die Folgen Fis-G-As bzw. E-F-Ges, auch Zigeuner-Moll genannt. Im Blues gibt es die Flat Fifth, aber in keiner bekannten Siebentonleiter steht etwas wie Fis-G-As-A. Vier Halbtöne nacheinander mag niemand hören.

e) Keine septatonische Tonleiter beginnt mit einer Terz

C-E kommt nicht vor, weil sonst D fehlen würde, nur "Hungarian Major" und "Bluesy Rock&Roll" beginnen mit C-Dis, also einer verminderten Terz.

5. Zur Untersuchung der 462 möglichen 7-Ton-Leitern

Im Abschnitt 7 habe ich alle 462 Möglichkeiten systematisch aufgeführt. Man erkennt sehr leicht, dass von den 462 möglichen septatonischen Leitern mindestens 360 „unbrauchbar“ sind, weil sie im Sinne der obigen „Erfahrungswerte“ zu viele Halbtöne schichten oder zu viele Töne auslassen. Unter den rein mathematisch möglichen septatonischen Leitern kommen z.B. auch die folgenden vor:

| | | | | | | | | | | | | |
|---|-----|---|-----|---|---|-----|---|-----|---|--|--|----|
| c | cis | d | dis | e | f | fis | | | | | | c' |
| c | cis | d | dis | e | f | | g | | | | | c' |
| c | cis | d | dis | e | f | | | gis | | | | c' |
| c | cis | d | dis | e | f | | | | a | | | c' |

Solche Leitern wird niemand für nützliche Tonleitern halten, weil keiner vier oder fünf Halbtöne nacheinander hören will.

Man erkennt aber auch, dass neben den 35 bekannten Leitern noch etwa 70 weitere liegen, die durch Erhöhung oder Verminderung einzelner Töne der bekannten Leitern entstehen.

Beispiel: Wenn man im melodischen Moll die Sexte erhöht, bekommt man ein schräges Moll, welches etwas fremd klingt, aber durchaus noch erträglich ist. Dafür gibt es aber keinen Namen.

| | | | | | | | | | | | | | |
|------------------|---|--|---|----|--|---|--|---|--|---|-----|---|---|
| Melodic Minor | C | | D | Eb | | F | | G | | A | | H | c |
| Melodisch schräg | C | | D | Eb | | F | | G | | | Ais | H | c |

6. Liste aller "brauchbaren" septatonischen Leitern

Die 35 allgemein bekannten Leitern habe ich farblich gekennzeichnet.
Die weißen Leitern, weitere 70, sind "brauchbar" nach den Regeln, die ich in Abschnitt 4 dargestellt habe.

| | | | | | | | | | | | | | |
|----------------------|---|----|---|----|---|---|--|---|----|---|---|---|---|
| Dur-artige | C | | D | | E | F | | G | | A | | H | c |
| Moll-artige | C | Db | | Eb | | F | | G | Ab | | | H | c |
| Kirchentonart | C | Db | | Eb | | F | | G | Ab | | B | | c |

| | | | | | | | | | | | | | |
|-----------------------|---|----|--|----|---|---|----|---|----|---|---|---|---|
| Ultralocrian | C | Db | | Eb | E | | F# | | G# | A | | | c |
| SuperLocrian | C | Db | | Eb | E | | Gb | | Ab | | B | | c |
| | C | Db | | Eb | E | | Gb | | Ab | | | H | c |
| | C | Db | | Eb | | F | Gb | | Ab | A | | | c |
| Locrian | C | Db | | Eb | | F | Gb | | Ab | | B | | c |
| | C | Db | | Eb | | F | Gb | | Ab | | | H | c |
| | C | Db | | Eb | | F | Gb | | | A | B | | c |
| | C | Db | | Eb | | F | Gb | | | A | | H | c |
| | C | Db | | Eb | | F | | G | Ab | A | | | c |
| Phrygian | C | Db | | Eb | | F | | G | Ab | | B | | c |
| NeapolitanMin | C | Db | | Eb | | F | | G | Ab | | | H | c |
| Phrygian #6 | C | Db | | Eb | | F | | G | | A | B | | c |
| NeapolitanMaj | C | Db | | Eb | | F | | G | | A | | H | c |
| | C | Db | | Eb | | F | | | G# | A | | H | c |
| | C | Db | | Eb | | | F# | G | Ab | | B | | c |
| Todi (Indian) | C | Db | | Eb | | | F# | G | Ab | | | H | c |
| | C | Db | | Eb | | | F# | G | | A | B | | c |
| | C | Db | | Eb | | | F# | G | | A | | H | c |
| | C | Db | | Eb | | | F# | | G# | A | B | | c |
| | C | Db | | Eb | | | F# | | G# | A | | H | c |
| | C | Db | | | E | F | Gb | | Ab | A | | | c |
| | C | Db | | | E | F | Gb | | Ab | | B | | c |
| PersianMajor | C | Db | | | E | F | Gb | | Ab | | | H | c |
| OrientalMajor | C | Db | | | E | F | Gb | | | A | B | | c |
| | C | Db | | | E | F | Gb | | | A | | H | c |
| | C | Db | | | E | F | | G | Ab | A | | | c |
| PhrygianMajor | C | Db | | | E | F | | G | Ab | | B | | c |
| Byzantine | C | Db | | | E | F | | G | Ab | | | H | c |
| | C | Db | | | E | F | | G | | A | B | | c |
| | C | Db | | | E | F | | G | | A | | H | c |
| | C | Db | | | E | F | | | Ab | A | B | | c |
| | C | Db | | | E | F | | | Ab | A | | H | c |
| | C | Db | | | E | | F# | G | Ab | | B | | c |
| | C | Db | | | E | | F# | G | Ab | | | H | c |
| | C | Db | | | E | | F# | G | | A | B | | c |
| Marva (Indian) | C | Db | | | E | | F# | G | | A | | H | c |
| | C | Db | | | E | | F# | | G# | A | B | | c |
| | C | Db | | | E | | F# | | G# | A | | H | c |
| Enigmatic | C | Db | | | E | | F# | | G# | | B | H | c |
| | C | Db | | | E | | | G | Ab | A | | H | c |

| | | | | | | | | | | | | | |
|---------------|---|--|---|----|---|---|----|----|----|---|---|---|---|
| Lydian augmen | C | | D | | E | | F# | | G# | A | | H | c |
| Leadng Whole | C | | D | | E | | Gb | | Ab | B | | H | c |
| | C | | D | | E | | G | Ab | A | | H | c | |
| | C | | D | | | F | Gb | | Ab | A | B | | c |
| | C | | | D# | E | F | | G | Ab | A | | | c |
| | C | | | D# | E | F | | G | Ab | | B | | c |
| | C | | | D# | E | F | | G | Ab | | | H | c |
| Bluesy R&R | C | | | D# | E | F | | G | | A | B | | c |
| | C | | | D# | E | F | | G | | A | | H | c |
| | C | | | D# | E | F | | | G# | A | B | | c |
| | C | | | D# | E | F | | | G# | A | | H | c |
| | C | | | D# | E | | F# | G | Ab | | B | | c |
| | C | | | D# | E | | F# | G | Ab | | | H | c |
| HungarianMaj | C | | | D# | E | | F# | G | | A | B | | c |
| | C | | | D# | E | | F# | G | | A | | H | c |
| | C | | | D# | E | | F# | | G# | A | B | | c |
| | C | | | D# | E | | F# | | G# | A | | H | c |
| | C | | | D# | E | | | G | Ab | A | | H | c |
| | C | | | D# | | F | F# | G | | A | B | | c |

7. Liste aller mathematisch möglichen septatonischen Leitern

Die folgende Liste enthält alle mathematisch möglichen septatonischen Leitern, auch die unsinnigen. Die allgemein bekannten Leitern habe ich farblich gekennzeichnet:

| | | | | | | | | | | | | | |
|----------------------|---|----|---|----|---|---|--|---|----|---|---|---|---|
| Dur-artige | C | | D | | E | F | | G | | A | | H | c |
| Moll-artige | C | Db | | Eb | | F | | G | Ab | | | H | c |
| Kirchentonart | C | Db | | Eb | | F | | G | Ab | | B | | c |

| | | | | | | | | | | | | | |
|--|---|----|---|----|---|---|----|---|----|----|----|----|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| | C | Db | D | Eb | E | F | Gb | | | | | | c |
| | C | Db | D | Eb | E | F | | G | | | | | c |
| | C | Db | D | Eb | E | F | | | Ab | | | | c |
| | C | Db | D | Eb | E | F | | | | A | | | c |
| | C | Db | D | Eb | E | F | | | | | B | | c |
| | C | Db | D | Eb | E | F | | | | | | H | c |
| | C | Db | D | Eb | E | | Gb | G | | | | | c |
| | C | Db | D | Eb | E | | Gb | | Ab | | | | c |
| | C | Db | D | Eb | E | | Gb | | | A | | | c |
| | C | Db | D | Eb | E | | Gb | | | | B | | c |
| | C | Db | D | Eb | E | | Gb | | | | | H | c |
| | C | Db | D | Eb | E | | | G | Ab | | | | c |
| | C | Db | D | Eb | E | | | G | | A | | | c |
| | C | Db | D | Eb | E | | | G | | | B | | c |
| | C | Db | D | Eb | E | | | G | | | | H | c |
| | C | Db | D | Eb | E | | | | Ab | A | | | c |
| | C | Db | D | Eb | E | | | | Ab | | B | | c |
| | C | Db | D | Eb | E | | | | Ab | | | H | c |
| | C | Db | D | Eb | E | | | | | A | B | | c |
| | C | Db | D | Eb | E | | | | | A | | H | c |
| | C | Db | D | Eb | E | | | | | | B | H | c |
| | C | Db | D | Eb | | F | Gb | G | | | | | c |
| | C | Db | D | Eb | | F | Gb | | Ab | | | | c |
| | C | Db | D | Eb | | F | Gb | | | A | | | c |
| | C | Db | D | Eb | | F | Gb | | | | B | | c |
| | C | Db | D | Eb | | F | Gb | | | | | H | c |
| | C | Db | D | Eb | | F | | G | Ab | | | | c |
| | C | Db | D | Eb | | F | | G | | A | | | c |
| | C | Db | D | Eb | | F | | G | | | B | | c |
| | C | Db | D | Eb | | F | | G | | | | H | c |
| | C | Db | D | Eb | | F | | | Ab | A | | | c |
| | C | Db | D | Eb | | F | | | Ab | | B | | c |
| | C | Db | D | Eb | | F | | | Ab | | | H | c |
| | C | Db | D | Eb | | F | | | | A | B | | c |
| | C | Db | D | Eb | | F | | | | A | | H | c |
| | C | Db | D | Eb | | F | | | | | B | H | c |
| | C | Db | D | Eb | | | Gb | G | Ab | | | | c |
| | C | Db | D | Eb | | | Gb | G | | A | | | c |
| | C | Db | D | Eb | | | Gb | G | | | B | | c |
| | C | Db | D | Eb | | | Gb | G | | | | H | c |

| | | | | | | | | | | | | | |
|--|---|----|---|----|---|-----|----|---|----|---|---|---|---|
| | C | Db | D | Eb | | | Gb | | Ab | A | B | | c |
| | C | Db | D | Eb | | | Gb | | Ab | | | H | c |
| | C | Db | D | Eb | | | Gb | | | A | B | | c |
| | C | Db | D | Eb | | | Gb | | | A | | H | c |
| | C | Db | D | Eb | | | Gb | | | | B | H | c |
| | C | Db | D | Eb | | | Gb | G | Ab | A | | | c |
| | C | Db | D | Eb | | | Gb | G | Ab | | B | | c |
| | C | Db | D | Eb | | | Gb | G | Ab | | | H | c |
| | C | Db | D | Eb | | | Gb | G | | A | B | | c |
| | C | Db | D | Eb | | | Gb | G | | A | | H | c |
| | C | Db | D | Eb | | | Gb | G | | | B | H | c |
| | C | Db | D | Eb | | | Gb | | Ab | A | B | | c |
| | C | Db | D | Eb | | | Gb | | Ab | A | | H | c |
| | C | Db | D | Eb | | | Gb | | Ab | | B | H | c |
| | C | Db | D | Eb | | | | | | A | B | H | c |
| | C | Db | D | | E | F | Gb | G | | | | | c |
| | C | Db | D | | E | F | Gb | | Ab | | | | c |
| | C | Db | D | | E | F | Gb | | | A | | | c |
| | C | Db | D | | E | F | Gb | | | | B | | c |
| | C | Db | D | | E | F | Gb | | | | | H | c |
| | C | Db | D | | E | F | | G | Ab | | | | c |
| | C | Db | D | | E | F | | G | | A | | | c |
| | C | Db | D | | E | F | | G | | | B | | c |
| | C | Db | D | | E | F | | G | | | | H | c |
| | C | Db | D | | E | F | | | Ab | A | | | c |
| | C | Db | D | | E | F | | | Ab | | B | | c |
| | C | Db | D | | E | F | | | Ab | | | H | c |
| | C | Db | D | | E | F | | | | A | B | | c |
| | C | Db | D | | E | F | | | | A | | H | c |
| | C | Db | D | | E | F | | | | | B | H | c |
| | C | Db | D | | E | | Gb | G | Ab | | | | c |
| | C | Db | D | | E | | Gb | G | | A | | | c |
| | C | Db | D | | E | | Gb | G | | | B | | c |
| | C | Db | D | | E | | Gb | G | | | | H | c |
| | C | Db | D | | E | | Gb | | Ab | A | | | c |
| | C | Db | D | | E | | Gb | | Ab | | B | | c |
| | C | Db | D | | E | | Gb | | Ab | | | H | c |
| | C | Db | D | | E | | Gb | | | A | B | | c |
| | C | Db | D | | E | | Gb | | | A | | H | c |
| | C | Db | D | | E | | Gb | | | | B | H | c |
| | C | Db | D | | E | | | G | Ab | A | | | c |
| | C | Db | D | | E | | | G | Ab | | B | | c |
| | C | Db | D | | E | | | G | Ab | | | H | c |
| | C | Db | D | | E | | | G | | A | B | | c |
| | C | Db | D | | E | | | G | | A | | H | c |
| | C | Db | D | | E | | | G | | | B | H | c |
| | C | Db | D | | E | | | | Ab | A | B | | c |
| | C | Db | D | | E | | | | Ab | A | | H | c |
| | C | Db | D | | E | | | | Ab | | B | H | c |
| | C | Db | D | | E | | | | | A | B | H | c |
| | C | Db | D | | | F-- | Gb | G | Ab | | | | c |
| | C | Db | D | | | F | Gb | G | | A | | | c |

| | | | | | | | | | | | | | |
|--|---|----|---|----|---|---|----|---|----|---|---|---|---|
| | C | Db | D | | | F | Gb | G | | | B | | C |
| | C | Db | D | | | F | Gb | G | | | H | | c |
| | C | Db | D | | | F | Gb | | Ab | A | | | c |
| | C | Db | D | | | F | Gb | | Ab | | B | | c |
| | C | Db | D | | | F | Gb | | Ab | | H | | c |
| | C | Db | D | | | F | Gb | | | A | B | | c |
| | C | Db | D | | | F | Gb | | | A | | H | c |
| | C | Db | D | | | F | Gb | | | | B | H | c |
| | C | Db | D | | | F | | G | Ab | A | | | c |
| | C | Db | D | | | F | | G | Ab | | B | | c |
| | C | Db | D | | | F | | G | Ab | | H | | c |
| | C | Db | D | | | F | | G | | A | B | | c |
| | C | Db | D | | | F | | G | | A | | H | c |
| | C | Db | D | | | F | | G | | | B | H | c |
| | C | Db | D | | | F | | | Ab | A | B | | c |
| | C | Db | D | | | F | | | Ab | A | | H | c |
| | C | Db | D | | | F | | | Ab | | B | H | c |
| | C | Db | D | | | F | | | | A | B | H | c |
| | C | Db | D | | | | Gb | G | Ab | A | | | c |
| | C | Db | D | | | | Gb | G | Ab | | B | | c |
| | C | Db | D | | | | Gb | G | Ab | | H | | c |
| | C | Db | D | | | | Gb | G | | A | B | | c |
| | C | Db | D | | | | Gb | G | | A | | H | c |
| | C | Db | D | | | | Gb | G | | | B | H | c |
| | C | Db | D | | | | Gb | | Ab | A | B | | c |
| | C | Db | D | | | | Gb | | Ab | A | | H | c |
| | C | Db | D | | | | Gb | | Ab | | B | H | c |
| | C | Db | D | | | | Gb | | | A | B | H | c |
| | C | Db | D | | | | | G | Ab | A | B | | c |
| | C | Db | D | | | | | G | Ab | A | | H | c |
| | C | Db | D | | | | | G | Ab | | B | H | c |
| | C | Db | D | | | | | G | | A | B | H | c |
| | C | Db | D | | | | | | Ab | A | B | H | c |
| | C | Db | | Eb | E | F | Gb | G | | | | | c |
| | C | Db | | Eb | E | F | Gb | | Ab | | | | c |
| | C | Db | | Eb | E | F | Gb | | | A | | | c |
| | C | Db | | Eb | E | F | Gb | | | | B | | c |
| | C | Db | | Eb | E | F | Gb | | | | | H | c |
| | C | Db | | Eb | E | F | | G | Ab | | | | c |
| | C | Db | | Eb | E | F | | G | | A | | | c |
| | C | Db | | Eb | E | F | | G | | | B | | c |
| | C | Db | | Eb | E | F | | G | | | | H | c |
| | C | Db | | Eb | E | F | | | Ab | A | | | c |
| | C | Db | | Eb | E | F | | | Ab | | B | | c |
| | C | Db | | Eb | E | F | | | Ab | | | H | c |
| | C | Db | | Eb | E | F | | | | A | B | | c |
| | C | Db | | Eb | E | F | | | | A | | H | c |
| | C | Db | | Eb | E | F | | | | | B | H | c |
| | C | Db | | Eb | E | | Gb | G | Ab | | | | c |
| | C | Db | | Eb | E | | Gb | G | | A | | | c |
| | C | Db | | Eb | E | | Gb | G | | | B | | c |
| | C | Db | | Eb | E | | Gb | G | | | | H | c |
| | C | Db | | Eb | E | | Gb | | Ab | A | | | c |

| | | | | | | | | | | | | | | | |
|----------------------|----------|-----------|--|--|----------|----------|-----------|----------|-----------|-----------|----------|----------|--|----------|----------|
| | C | Db | | | E | F | Gb | G | | Ab | A | | | H | C |
| | C | Db | | | E | F | Gb | | | Ab | | B | | | c |
| PersianMajor | C | Db | | | E | F | Gb | | | Ab | | | | H | c |
| OrientalMajor | C | Db | | | E | F | Gb | | | | A | B | | | c |
| | C | Db | | | E | F | Gb | | | A | | | | H | c |
| | C | Db | | | E | F | Gb | | | | | B | | H | c |
| | C | Db | | | E | F | | G | Ab | A | | | | | c |
| PhrygianMajor | C | Db | | | E | F | | G | Ab | | | B | | | c |
| Byzantine | C | Db | | | E | F | | G | Ab | | | | | H | c |
| | C | Db | | | E | F | | G | | A | B | | | | c |
| | C | Db | | | E | F | | G | | A | | | | H | c |
| | C | Db | | | E | F | | G | | | B | | | H | c |
| | C | Db | | | E | F | | | Ab | A | B | | | | c |
| | C | Db | | | E | F | | | Ab | A | | | | H | c |
| | C | Db | | | E | F | | | Ab | | B | | | H | c |
| | C | Db | | | E | F | | | | A | B | | | H | c |
| | C | Db | | | E | | Gb | G | Ab | A | | | | | c |
| | C | Db | | | E | | Gb | G | Ab | | | B | | | c |
| | C | Db | | | E | | Gb | G | Ab | | | | | H | c |
| | C | Db | | | E | | Gb | G | | A | B | | | | c |
| | C | Db | | | E | | Gb | G | | A | | | | H | c |
| | C | Db | | | E | | Gb | G | | | B | | | H | c |
| | C | Db | | | E | | Gb | | Ab | A | B | | | | c |
| | C | Db | | | E | | Gb | | Ab | A | | | | H | c |
| Enigmatic | C | Db | | | E | | Gb | | | Ab | | B | | H | c |
| | C | Db | | | E | | Gb | | | A | B | | | H | c |
| | C | Db | | | E | | | G | Ab | A | B | | | | c |
| | C | Db | | | E | | | G | Ab | A | | | | H | c |
| | C | Db | | | E | | | G | Ab | | B | | | H | c |
| | C | Db | | | E | | | G | | A | B | | | H | c |
| | C | Db | | | E | | | | Ab | A | B | | | H | c |
| | C | Db | | | | F | Gb | G | Ab | A | | | | | c |
| | C | Db | | | | F | Gb | G | Ab | | | B | | | c |
| | C | Db | | | | F | Gb | G | Ab | | | | | H | c |
| | C | Db | | | | F | Gb | G | | A | B | | | | c |
| | C | Db | | | | F | Gb | G | | A | | | | H | c |
| | C | Db | | | | F | Gb | G | | | | B | | H | c |
| | C | Db | | | | F | Gb | | Ab | A | B | | | | c |
| | C | Db | | | | F | Gb | | Ab | A | | | | H | c |
| | C | Db | | | | F | Gb | | Ab | | B | | | H | c |
| | C | Db | | | | F | Gb | | | A | B | | | H | c |
| | C | Db | | | | F | | G | Ab | A | B | | | | c |
| | C | Db | | | | F | | G | Ab | A | | | | H | c |
| | C | Db | | | | F | | G | Ab | | B | | | H | c |
| | C | Db | | | | F | | | Ab | A | B | | | H | c |
| | C | Db | | | | | Gb | G | Ab | A | B | | | | c |
| | C | Db | | | | | Gb | G | Ab | A | | | | H | c |
| | C | Db | | | | | Gb | G | Ab | | | B | | H | c |
| | C | Db | | | | | Gb | G | | A | B | | | H | c |
| | C | Db | | | | | Gb | | Ab | A | B | | | H | c |
| | C | Db | | | | | | G | Ab | A | B | | | H | c |

| | | | | | | | | | | | | | |
|----------------------|----------|--|----------|-----------|---|----------|-----------|----------|-----------|----------|----------|----------|----------|
| | C | | D | E♭ | E | F | G♭ | G | | Ab | | | c |
| | C | | D | E♭ | E | F | G♭ | | | A | | | c |
| | C | | D | E♭ | E | F | G♭ | | | | B | | c |
| | C | | D | E♭ | E | F | G♭ | | | | | H | c |
| | C | | D | E♭ | E | F | | G | Ab | | | | c |
| | C | | D | E♭ | E | F | | G | | A | | | c |
| | C | | D | E♭ | E | F | | G | | | B | | c |
| | C | | D | E♭ | E | F | | G | | | | H | c |
| | C | | D | E♭ | E | F | | | Ab | A | | | c |
| | C | | D | E♭ | E | F | | | Ab | | B | | c |
| | C | | D | E♭ | E | F | | | Ab | | | H | c |
| | C | | D | E♭ | E | F | | | | A | B | | c |
| | C | | D | E♭ | E | F | | | | A | | H | c |
| | C | | D | E♭ | E | F | | | | | B | H | c |
| | C | | D | E♭ | E | | G♭ | G | Ab | | | | c |
| | C | | D | E♭ | E | | G♭ | G | | A | | | c |
| | C | | D | E♭ | E | | G♭ | G | | | B | | c |
| | C | | D | E♭ | E | | G♭ | G | | | | H | c |
| | C | | D | E♭ | E | | G♭ | | Ab | A | | | c |
| | C | | D | E♭ | E | | G♭ | | Ab | | B | | c |
| | C | | D | E♭ | E | | G♭ | | Ab | | | H | c |
| | C | | D | E♭ | E | | G♭ | | | A | B | | c |
| | C | | D | E♭ | E | | G♭ | | | A | | H | c |
| | C | | D | E♭ | E | | G♭ | | | | B | H | c |
| | C | | D | E♭ | E | | | G | Ab | A | | | c |
| | C | | D | E♭ | E | | | G | Ab | | B | | c |
| | C | | D | E♭ | E | | | G | Ab | | | H | c |
| | C | | D | E♭ | E | | | G | | A | B | | c |
| | C | | D | E♭ | E | | | G | | A | | H | c |
| | C | | D | E♭ | E | | | G | | | B | H | c |
| | C | | D | E♭ | E | | | | Ab | A | B | | c |
| | C | | D | E♭ | E | | | | Ab | A | | H | c |
| | C | | D | E♭ | E | | | | Ab | | B | H | c |
| | C | | D | E♭ | E | | | | | A | B | H | c |
| | C | | D | E♭ | | F | G♭ | G | Ab | | | | c |
| | C | | D | E♭ | | F | G♭ | G | | A | | | c |
| | C | | D | E♭ | | F | G♭ | G | | | B | | c |
| | C | | D | E♭ | | F | G♭ | G | | | | H | c |
| | C | | D | E♭ | | F | G♭ | | Ab | A | | | c |
| Locrian #2 | C | | D | E♭ | | F | G♭ | | Ab | | B | | c |
| | C | | D | E♭ | | F | G♭ | | Ab | | | H | c |
| | C | | D | E♭ | | F | G♭ | | | A | B | | c |
| | C | | D | E♭ | | F | G♭ | | | A | | H | c |
| | C | | D | E♭ | | F | G♭ | | | | B | H | c |
| | C | | D | E♭ | | F | | G | Ab | A | | | c |
| Minor=Aeolian | C | | D | E♭ | | F | | G | Ab | | B | | c |
| HarmonicMinor | C | | D | E♭ | | F | | G | Ab | | | H | c |
| Dorian | C | | D | E♭ | | F | | G | | A | B | | c |
| Melodic Minor | C | | D | E♭ | | F | | G | | A | | H | c |
| | C | | D | E♭ | | F | | G | | | B | H | c |
| | C | | D | E♭ | | F | | | Ab | A | B | | c |
| | C | | D | E♭ | | F | | | Ab | A | | H | c |

| | | | | | | | | | | | | | |
|----------------------|----------|--|----------|-----------|----------|----------|-----------|----------|-----------|----------|----------|----------|----------|
| | C | | D | E♭ | | F | | | | A | B | H | c |
| | C | | D | E♭ | | | G♭ | G | Ab | A | | | c |
| HungariaGypsy | C | | D | E♭ | | | G♭ | G | Ab | | B | | c |
| HungariaMinor | C | | D | E♭ | | | F♯ | G | Ab | | | H | c |
| RomanianMinor | C | | D | E♭ | | | G♭ | G | | A | B | | c |
| | C | | D | E♭ | | | G♭ | G | | A | | H | c |
| | C | | D | E♭ | | | G♭ | G | | | B | H | c |
| | C | | D | E♭ | | | G♭ | | Ab | A | B | | c |
| | C | | D | E♭ | | | G♭ | | Ab | A | | H | c |
| | C | | D | E♭ | | | G♭ | | Ab | | B | H | c |
| | C | | D | E♭ | | | G♭ | | | A | B | H | c |
| | C | | D | E♭ | | | G♭ | G | Ab | A | B | | c |
| | C | | D | E♭ | | | G♭ | G | Ab | A | | H | c |
| | C | | D | E♭ | | | G♭ | G | Ab | | B | H | c |
| | C | | D | E♭ | | | G♭ | G | | A | B | H | c |
| | C | | D | E♭ | | | G♭ | | Ab | A | B | H | c |
| | C | | D | | E | F | G♭ | G | Ab | | | | c |
| | C | | D | | E | F | G♭ | G | | A | | | c |
| | C | | D | | E | F | G♭ | G | | | B | | c |
| | C | | D | | E | F | G♭ | G | | | | H | c |
| | C | | D | | E | F | G♭ | | Ab | A | | | c |
| LocrianMajor | C | | D | | E | F | G♭ | | Ab | | B | | c |
| | C | | D | | E | F | G♭ | | Ab | | | H | c |
| | C | | D | | E | F | G♭ | | | A | B | | c |
| | C | | D | | E | F | G♭ | | | A | | H | c |
| | C | | D | | E | F | G♭ | | | | B | H | c |
| | C | | D | | E | F | | G | Ab | A | | | c |
| Myxolydian b6 | C | | D | | E | F | | G | Ab | | B | | c |
| | C | | D | | E | F | | G | Ab | | | H | c |
| Myxolydian | C | | D | | E | F | | G | | A | B | | c |
| Major=Ionian | C | | D | | E | F | | G | | A | | H | c |
| | C | | D | | E | F | | G | | | B | H | c |
| | C | | D | | E | F | | | Ab | A | B | | c |
| Jewish Major | C | | D | | E | F | | | G♯ | A | | H | c |
| | C | | D | | E | F | | | Ab | | B | H | c |
| | C | | D | | E | F | | | | A | B | H | c |
| | C | | D | | E | | G♭ | G | Ab | A | | | c |
| Lydian Minor | C | | D | | E | | F♯ | G | Ab | | B | | c |
| | C | | D | | E | | G♭ | G | Ab | | | H | c |
| Lydian b7 | C | | D | | E | | G♭ | G | | A | B | | c |
| Lydian | C | | D | | E | | F♯ | G | | A | | H | c |
| | C | | D | | E | | G♭ | G | | | B | H | c |
| | C | | D | | E | | G♭ | | Ab | A | B | | c |
| Lydian augmen | C | | D | | E | | F♯ | | G♯ | A | | H | c |
| Leadng Whole | C | | D | | E | | G♭ | | Ab | | B | H | c |
| | C | | D | | E | | G♭ | | | A | B | H | c |
| | C | | D | | E | | | G | Ab | A | B | | c |
| | C | | D | | E | | | G | Ab | A | | H | c |
| | C | | D | | E | | | G | Ab | | B | H | c |
| | C | | D | | E | | | G | | A | B | H | c |
| | C | | D | | E | | | | Ab | A | B | H | c |
| | C | | D | | | F | G♭ | G | Ab | A | | | c |

| | | | | | | | | | | | | | |
|---------------------|----------|--|---|-----------|----------|---|-----------|----------|----|----------|----------|---|----------|
| | C | | D | | | F | Gb | G | Ab | | | H | c |
| | C | | D | | | F | Gb | G | | A | B | | c |
| | C | | D | | | F | Gb | G | | A | | H | c |
| | C | | D | | | F | Gb | G | | | B | H | c |
| | C | | D | | | F | Gb | | Ab | A | B | | c |
| | C | | D | | | F | Gb | | Ab | A | | H | c |
| | C | | D | | | F | Gb | | Ab | | B | H | c |
| | C | | D | | | F | Gb | | | A | B | H | c |
| | C | | D | | | F | | G | Ab | A | B | | c |
| | C | | D | | | F | | G | Ab | A | | H | c |
| | C | | D | | | F | | G | Ab | | B | H | c |
| | C | | D | | | F | | G | | A | B | H | c |
| | C | | D | | | F | | | Ab | A | B | H | c |
| | C | | D | | | | Gb | G | Ab | A | B | | c |
| | C | | D | | | | Gb | G | Ab | A | | H | c |
| | C | | D | | | | Gb | G | Ab | | B | H | c |
| | C | | D | | | | Gb | G | | A | B | H | c |
| | C | | D | | | | Gb | | Ab | A | B | H | c |
| | C | | D | | | | | G | Ab | A | B | H | c |
| | C | | | Eb | E | F | Gb | G | Ab | | | | c |
| | C | | | Eb | E | F | Gb | G | | A | | | c |
| | C | | | Eb | E | F | Gb | G | | | B | | c |
| | C | | | Eb | E | F | Gb | G | | | | H | c |
| | C | | | Eb | E | F | Gb | | Ab | A | | | c |
| | C | | | Eb | E | F | Gb | | Ab | | B | | c |
| | C | | | Eb | E | F | Gb | | Ab | | | H | c |
| | C | | | Eb | E | F | Gb | | | A | B | | c |
| | C | | | Eb | E | F | Gb | | | A | | H | c |
| | C | | | Eb | E | F | Gb | | | | B | H | c |
| | C | | | Eb | E | F | | G | Ab | A | | | c |
| | C | | | Eb | E | F | | G | Ab | | B | | c |
| | C | | | Eb | E | F | | G | Ab | | | H | c |
| | C | | | Eb | E | F | | G | | A | B | | c |
| | C | | | Eb | E | F | | G | | A | | H | c |
| | C | | | Eb | E | F | | G | | | B | H | c |
| | C | | | Eb | E | F | | | Ab | A | B | | c |
| | C | | | Eb | E | F | | | Ab | A | | H | c |
| | C | | | Eb | E | F | | | Ab | | B | H | c |
| | C | | | Eb | E | F | | | | A | B | H | c |
| | C | | | Eb | E | | Gb | G | Ab | A | | | c |
| | C | | | Eb | E | | Gb | G | Ab | | B | | c |
| | C | | | Eb | E | | Gb | G | Ab | | | H | c |
| HungarianMaj | C | | | D# | E | | F# | G | | A | B | | c |
| | C | | | Eb | E | | Gb | G | | A | | H | c |
| | C | | | Eb | E | | Gb | G | | | B | H | c |
| | C | | | Eb | E | | Gb | | Ab | A | B | | c |
| | C | | | Eb | E | | Gb | | Ab | A | | H | c |
| | C | | | Eb | E | | Gb | | Ab | | B | H | c |
| | C | | | Eb | E | | Gb | | | A | B | H | c |
| | C | | | Eb | E | | | G | Ab | A | B | | c |
| | C | | | Eb | E | | | G | Ab | A | | H | c |
| | C | | | Eb | E | | | G | Ab | | B | H | c |

| | | | | | | | | | | | | | |
|--|---|--|--|----|---|---|----|---|----|---|---|---|---|
| | C | | | Eb | E | | | | Ab | A | B | H | c |
| | C | | | Eb | | F | Gb | G | Ab | A | | | c |
| | C | | | Eb | | F | Gb | G | Ab | | B | | c |
| | C | | | Eb | | F | Gb | G | Ab | | | H | c |
| | C | | | Eb | | F | Gb | G | | A | B | | c |
| | C | | | Eb | | F | Gb | G | | A | | H | c |
| | C | | | Eb | | F | Gb | G | | | B | H | c |
| | C | | | Eb | | F | Gb | | Ab | A | B | | c |
| | C | | | Eb | | F | Gb | | Ab | A | | H | c |
| | C | | | Eb | | F | Gb | | Ab | | B | H | c |
| | C | | | Eb | | F | Gb | | | A | B | H | c |
| | C | | | Eb | | F | | G | Ab | A | B | | c |
| | C | | | Eb | | F | | G | Ab | A | | H | c |
| | C | | | Eb | | F | | G | Ab | | B | H | c |
| | C | | | Eb | | F | | G | | A | B | H | c |
| | C | | | Eb | | F | | | Ab | A | B | H | c |
| | C | | | Eb | | | Gb | G | Ab | A | B | | c |
| | C | | | Eb | | | Gb | G | Ab | A | | H | c |
| | C | | | Eb | | | Gb | G | Ab | | B | H | c |
| | C | | | Eb | | | Gb | G | | A | B | H | c |
| | C | | | Eb | | | Gb | | Ab | A | B | H | c |
| | C | | | Eb | | | Gb | G | Ab | A | B | H | c |
| | C | | | | E | F | Gb | G | Ab | A | | | c |
| | C | | | | E | F | Gb | G | Ab | | B | | c |
| | C | | | | E | F | Gb | G | Ab | | | H | c |
| | C | | | | E | F | Gb | G | | A | B | | c |
| | C | | | | E | F | Gb | G | | A | | H | c |
| | C | | | | E | F | Gb | G | | | B | H | c |
| | C | | | | E | F | Gb | | Ab | A | B | | c |
| | C | | | | E | F | Gb | | Ab | A | | H | c |
| | C | | | | E | F | Gb | | Ab | | B | H | c |
| | C | | | | E | F | Gb | | | A | B | H | c |
| | C | | | | E | F | | G | Ab | A | B | | c |
| | C | | | | E | F | | G | Ab | A | | H | c |
| | C | | | | E | F | | G | Ab | | B | H | c |
| | C | | | | E | F | | G | | A | B | H | c |
| | C | | | | E | F | | | Ab | A | B | H | c |
| | C | | | | E | | Gb | G | Ab | A | B | | c |
| | C | | | | E | | Gb | G | Ab | A | | H | c |
| | C | | | | E | | Gb | G | Ab | | B | H | c |
| | C | | | | E | | Gb | G | | A | B | H | c |
| | C | | | | E | | Gb | | Ab | A | B | H | c |
| | C | | | | E | | | G | Ab | A | B | H | c |
| | C | | | | | F | Gb | G | Ab | A | B | | c |
| | C | | | | | F | Gb | G | Ab | A | | H | c |
| | C | | | | | F | Gb | G | Ab | | B | H | c |
| | C | | | | | F | Gb | G | | A | B | H | c |
| | C | | | | | F | Gb | | Ab | A | B | H | c |
| | C | | | | | F | | G | Ab | A | B | H | c |
| | C | | | | | | Gb | G | Ab | A | B | H | c |