

The Origin of the Major and Minor Modes (Concluded)

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## THE ORIGIN OF THE MAJOR AND MINOR MODES.

BY KATHLEEN SCHLESINGER.

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(Concluded from July number, page 301.)

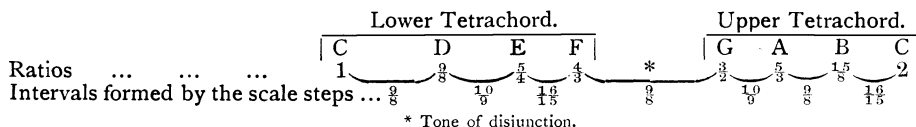
We now turn to the major and minor modes as we know them to-day, and review their characteristics.

The major mode in just intonation presents the following intervals from the tonic: (a) major 2nd (9:8), (b) major 3rd (5:4), (c) perfect 4th (4:3), (d) perfect 5th (3:2), (e) major 6th (5:3), (f) major 7th (15:8).

This scale may be analysed into two equal tetrachords between which is the 'tone of disjunction,' a major 2nd (9:8).

FIG. 6.

Tetrachordal Division of the Major Scale with Ratios and Intervals.

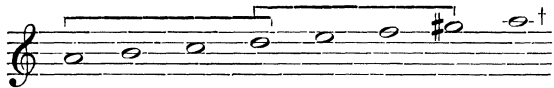


There are three forms of the minor scale, which are not, as conventionally taught, modifications of one another, but three types having distinct origins.

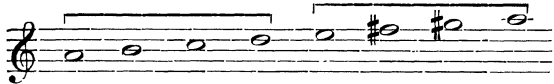
FIG. 7.

The Three Forms of the Minor Scale.

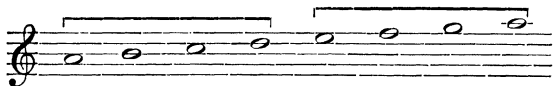
- (1.) The Harmonic Minor (Conjunct, or overlapping):



- (2.) The 1st Melodic (Disjunct):



- (3.) The 2nd Melodic (Disjunct):



† Interval of disjunction.

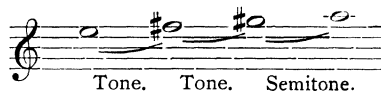
Each of the above scales is used up or down.

The following essentials are common to all three forms:

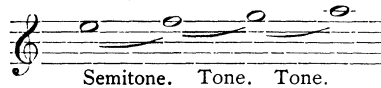
- A minor 3rd (6:5) on the tonic with its complementary major 6th (5:3) on the mediant;
- A perfect 4th (4:3) on the tonic;
- A perfect 5th (3:2) on the tonic.

The differences are all to be found in the upper tetrachord, composed of

- An augmented 2nd between two semitones (a very baffling construction); and
- Two tones and a semitone, viz., a major tetrachord on E:



- (3.) Of a Dorian† tetrachord:



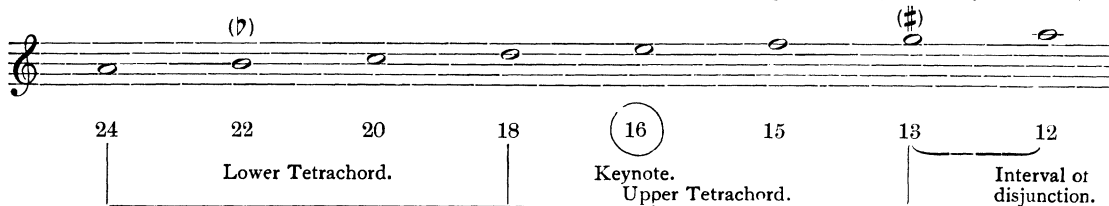
The prototypes of these three minor scales and of our major scale are *four ancient sequences*, three of which are based upon the law of the aliquot division of strings already explained.

By doubling the number of the Tropos, i.e., dividing the string into 24 parts instead of 12, and using the corresponding ratios, a scale of extended range is obtained. Expressed in the symbols of our notation, the result shows between ratios 24 and 12, an octave scale from A to A which corresponds to our harmonic A minor; the tonality, however, is not that of A minor but of E minor. The F is natural, as the 15th ratio reversed, from the generator or keynote E; F# would be the 14th ratio, which is not used in this sequence. A is only the apparent tonic or drone note, the real keynote (or Mese) being E on the 5th degree of the scale (the 16th ratio), an octave of the generator of the Tropos.

FIG 8.

Origin of the Harmonic Minor. In the 24 Tropos on the A string. Key E minor.

(The bracketed accidentals over notes show shades of intonation not expressible by ordinary notation.)



(N.B.—The G as 13th is considerably sharpened, and in fact nearer in pitch to G#. This may be verified by turning to Fig. 5 and comparing the values for ratio 13, which is B# (#) in the same Tropos on the C string.)

As the principle of the generation of the various Tropoi has been demonstrated (see July number), it is unnecessary to repeat the process here.

† The nomenclature of modes used refers throughout to the ancient Greek and not to the Ecclesiastical modes.

But what of the intonation? To study the intonation of the Tropos scales is to realise vividly what the Greeks meant by the *Ethos* of their modal sequences; in fact the Tropoi form the clue to the mystery of Greek music which has baffled so many writers on the subject.

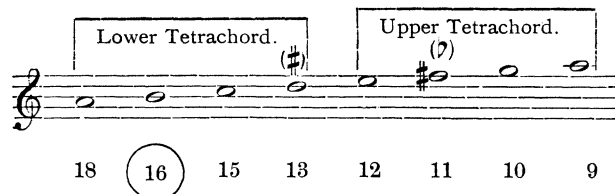
In the 24 Tropos we find the A to C (24 : 20 or 6 : 5) as a correct minor 3rd; A to D, a perfect 4th; from A to E a perfect 5th (24 : 16 or 3 : 2); from A to F a minor 6th (24 : 15 or 8 : 5). The interval F to G#

(15 : 13) is a very characteristic augmented 2nd (the ratio 13 precludes its being called a small minor 3rd). This 13th (G#) is a very flat 6th to the generator E, and in the reversed series of the Tropos it is first as sharp to the apparent tonic A, having very nearly the value of G#.

The origin of our Harmonic Minor Scale is thus a very ancient sequence, and a favourite pipe-scale in the ancient East.

FIG. 9.

The Origin of the Melodic Minor, Descending Form. The 18 Tropos (in B minor) on the A string.



The F(7) as 11th ratio approximate to F# on the pianoforte keyboard as expressed below.

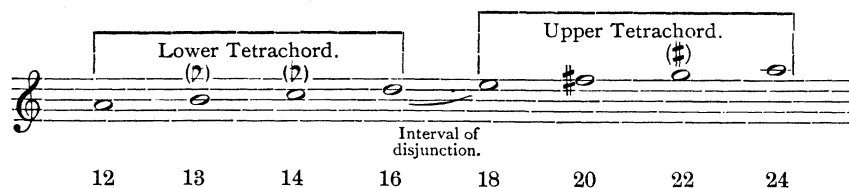
The first tetrachord in the Melodic Minor Scale (descending form) is identical in composition with the upper tetrachord of the Phrygian Tropos 24, shown in Fig. 8, and contains the characteristic minor 3rd, 6 : 5 (= 18 : 15), between A and C; but the 4th (13) is sharp to the extent that the interval of disjunction falls short of a major tone. The upper tetrachord begins on the dominant, a perfect 5th of the tonic C, and based upon it is a minor 3rd G, 12 : 10 (= 6 : 5), followed by the minor tone 10 : 9, A. The only unusual intervals are those formed by the characteristic 11th, which subdivides the minor 3rd, giving with 12 an interval smaller than the major tone by the exact amount of the excess over a semitone produced by the ratio 11 : 10. The flatness of the 11th, which in our notation would be F# (see analogy in Fig. 5), where the values are given), brings it down very nearly to F. During the period of Greek music characterized by

the work of Aristoxenus, these natural ratios which constituted the essence of the *Ethos* of the Modes were swept away to make room for a system of artificial temperament very nearly akin to our own. The 13th was replaced by the lower note 13½, or 27, while the 11th was raised to 10½, or 21 in the Tropos scale we have been considering, which then assumed the form which we know as the melodic minor, descending form.

The origin of the ascending form of the melodic minor is not a Tropos but a *Harmonia*, or octave scale, derived from a segment of the harmonic series lying between numbers 12 and 24 (the reverse or Tropos form of which gave us the harmonic minor). As this scale begins on A, as 12th harmonic, its keynote or octave of the fundamental is a 5th below, on D. Thus in this view the scale of A minor is derived from the key of D major.

FIG. 10.

Origin of the Melodic Minor (ascending form, from A). The Harmonia, 12 to 24 (in D major).



Later, the flattened 13th and 14th were raised to 13½ (or 27), and 14½ (or 29), which left the minor 3rd slightly too sharp and reduced the septimal tone 14 : 16, or 7 : 8. The C# which belongs to our scale of D major occurs on the 15th, which is replaced by the 14th in the Harmonia, so that the C is natural. The sharp 11th, which was nearer G# than G, was raised by the same process of levelling to the position of leading-note.

Tropos scales were the earliest scales in use all over the ancient world, and although they were temporarily displaced amongst the professional musicians and the theorists of all civilizations, yet we know by the pipes which tell their own tale that they lived in the popular music, and they linger to the present day in the folk-songs of all nations.

B

This assertion is not a mere hypothesis founded upon theories based upon natural laws, but an explanation based upon the results of investigations carried out with:

- (1.) Facsimiles of a number of actual pipes and flutes recovered from the tombs of ancient Egypt and Greece, and preserved in the museums of Europe;
- (2.) With certain specimens of the pipes of primitive races, belonging to the ethnographical collections of our own British Museum, examined by courtesy of the officers of the department concerned;
- (3.) With experimental and test-pipes supplementing the originals available.

The results of these investigations, comprising exact measurements of the pipes, a description of the nature and proportions of the straw mouthpieces used in playing them, and the necessary calculations of the ratios establishing Tropos or Harmonia, are embodied in a report addressed to the Institute of Archaeology (Faculty of Arts) of the University of Liverpool.

### THREE STAGES OF DEVELOPMENT.

The numerous pipes tested indicate three distinct stages in the development of this natural system of music.

The *first* consists of the Tropos or pipe-scales pure and simple, which provide examples of the best-known scales of ancient Greece.

The *second* stage is one of transition, during which the desire to make the pipe-scales approximate to the sequences of the harmonic series becomes evident. It is not suggested that the ancients adopted the pipe-scales by choice, but of necessity. It is easy enough to bore equidistant holes laterally in a pipe, but it is quite another thing to find the proper position that will give the sequences of various segments of the harmonic series without a knowledge of the ratios.

The *third* stage furnishes examples of the attainment of this object. After these octave segments known as Harmoniai had undergone certain modifications during the later period of Greek music, they formed the basis of the Ecclesiastical Modes of Ambrose and Gregory.

In addition to the above, a *fourth* stage in the development of music in antiquity was reached of which there is abundant literary evidence. During this period we find scales constructed with two equal and exactly similar tetrachords, a sequence which does not occur in the natural harmonic series.

### A FORTUITOUS DISCOVERY.

It is probable that this change came about quite naturally in the first instance, through the art of the virtuoso, who stumbled upon the discovery. To see how this was done, it is necessary to recall the structural details of the pipes given at the beginning of this article.

The mouthpiece consists of a piece of straw, having a vibrating tongue some three centimetres long. Three holes suffice on a pipe to give a tetrachord, and that interval also constitutes the normal range of the mouthpiece, without forcing the breath-pressure unduly. With a suitable mouthpiece, it is easy on these pipes with the same fingering to reduce the vibrating tongue of the reed mouthpiece, by a mere movement of the lips, to two-thirds of its length, whereupon the pipe speaks a fifth higher and repeats the original tetrachord on the dominant.

If this be done on a pipe having three holes bored according to the  $\frac{2}{3}$  Tropos, the result is our major scale, possessing all the essentials mentioned above.

FIG. 11.

The 20 Tropos Octave Scale. Origin of our Major Scale. C string, in E minor.

	Lower Tetrachord.				Upper Tetrachord.			
Ratios ...	20	18	16	15	13	12	11	10
Vibrations p.s. (Tropos Values)	64	71 $\frac{1}{3}$	80	85 $\frac{1}{3}$	98 $\frac{2}{3}$	106 $\frac{2}{3}$	116 $\frac{4}{11}$	128
Pianoforte Values (Philosophical Pitch)	64	71 $\frac{5}{8}$	80 $\frac{3}{4}$	85 $\frac{7}{16}$	95 $\frac{9}{16}$	107 $\frac{3}{8}$	120 $\frac{5}{8}$	128

Each number of the Tropos corresponds to a segment of string or pipe. In the harmonic series the diatonic octave lies between numbers 8-16, the chromatic between 16 and 32; if, as in this instance, a diatonic scale should extend beyond 16, the odd numbers of the chromatic notes must be omitted; 20 and 18 are merely 10 and 9 taken an octave lower.

The tetrachord C D E F is therefore the earliest origin of our major scale, although derived, as shown above, from the scale of E minor. When repeated through the same holes of the pipe by means of the natural manipulation of the reed mouthpiece, already explained, the same tetrachord starts again on the dominant, as shown in Fig. 12:

FIG. 12.

The 20-Tropos Scale on the Pipe with three holes, giving a complete Major Scale composed of Two Exactly Similar Tetrachords.

Vibrations p.s. (Pianoforte) ..	64	71 $\frac{5}{8}$	80 $\frac{3}{4}$	85 $\frac{7}{16}$	95 $\frac{9}{16}$	107 $\frac{3}{8}$	120 $\frac{5}{8}$	128
Vibrations p.s. (Pipe: Just Intonation)	64	71 $\frac{1}{2}$	80	85 $\frac{1}{3}$	96	106 $\frac{2}{3}$	120	128

•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•
C	D	E	F	G	A	B	C

Pipe in E min., lowest note C.

Pipe in B min., lowest note G.

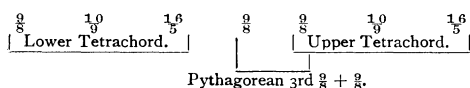
It will be noticed, by comparison with the ratios of the major scale given in Fig. 6, that the sole difference between the pipe-scale in Fig. 12 and the major scale is the inversion of the ratios  $9:8 + 10:9 = 5:4$  of the lower tetrachord, which in the pipe-scale are  $10:9 + 9:8 = 5:4$ . These ratios are not arbitrarily selected and put together; they form part of one of nature's inevitable sequences resulting from the boring of holes in the pipe. The difference between the two scales is one of a comma =  $81:80$ , between the D  $10:9$  of the Tropos and the D  $9:8$  of the modern scale.

The arrangement of the components of the tetrachord in the Lydian Tropos  $\frac{1}{2}b$ , i.e.,  $10:9, 9:8, 16:15$ , actually characterises the upper tetrachord of our major scale (just intonation) at the present day.

This structural feature of our major scale has a two-fold significance: (1) it indicates nature's harmonic law by making the two tetrachords fall short of absolute identity; (2) it establishes the fact that it is homogeneous in tonality, i.e., it is derived from one key, not two, viz., from a natural minor relative located a major 3rd above the tonic.

The C major scale is thus fundamentally derived from the Tropos key of E min. The  $F\sharp$  belonging to that key falls out, being the harmonic 7th reversed of E which is not used in the scale, as it is replaced by the 15th, one semitone above the keynote.

It is generally stated that our major scale is composed of a tetrachord in C and of another in G. If this were so, a modulation to the dominant would give:



a scale containing a Pythagorean 3rd (produced by the redundancy of the major tone  $\frac{8}{5}$  after the tone of disjunction) on the subdominant between F and A, and a major 6th on the tonic C to A sharpened by a comma,  $\frac{7}{5}$  instead of  $\frac{5}{3}$ . In the ancient original Tropos scale the tonality was certainly homogeneous in one sense, since the upper tetrachord was produced through the same holes as the lower, and the change in pitch was effected solely through the agency of the reed mouthpiece. This change affects the timbre of the instrument, giving it a second register.

#### HOW WERE THE ANCIENT PIPE-SCALES PRESERVED?

Many interesting questions arise out of the origin of our Modes from the ancient pipe-scales, which would lead us far beyond the scope of this article.

The three distinctive forms of the minor Mode, which concern the upper tetrachord only, are founded entirely upon the peculiarities of the natural intonation of these ancient scales, of which they represent the approximation in the tempered system.

These peculiarities are not to be traced in the later Greek musical system remodelled by Aristoxenus and his successors.

How then did they reach Western Europe with intonation intact? They were preserved by wandering musicians from the days of the fall of the Roman Empire; by minstrels, and *estrumenteurs*, by guilds of pipers, and others. The universally beloved reed pipe, under its various names—*shawm*, *schalmey*, *chalamel*, *chalumeau*, *musette*, *muse de blé*, *cornemuse*, &c.—and the many varieties of bagpipes in use during the Middle Ages, kept alive the tradition of the ancient Tropos scales, which survive with correct intonation in the folk-songs of various nations. These pipes imposed their own tonality and sequences upon the people who used them, and upon other instruments played in concert with them—*flutes*,

*recorders*, *flageolets*, the earliest types of which likewise had equidistant holes as late as the 15th and 16th centuries—and later still in the countryside, exercised the same influence upon the tonality and intonation of the secular music of the West.

It will thus be seen that the acceptance by the folk of all ages and nations of the extreme subtleties of intonation introduced by the Tropos or pipe-scale—of which, owing to the exigencies of space, not much more than a hint has been given—must be accepted as an incontrovertible musical fact, for which abundant evidence exists.

The universal popularity of the reed-blown pipes and flutes with equidistant holes, from remote antiquity to the present day, in ritual, secular, and rural music, furnishes overwhelming proof of the reality and practical use of these so-called acoustic scales.

#### A SICILIAN FLUTE.

A flute bored with equidistant holes, made by a Sicilian peasant, and presented to the writer by Mrs. Ludwig Mond, gives a pure Phrygian  $\frac{1}{2}b$  Tropos scale. The rustic pipe-maker has not been baffled by the allowances necessitated by the very wide calibre of the bore in relation to the length of the pipe, on account of diameter, but has grappled successfully with the problem of compensation in placing the first hole of the series.

This demonstrates the fact that the Phrygian Tropos is so firmly established in the consciousness and affections of the Sicilian peasants that they will not accept the substitute which a disregard of the laws of diameter—still in a semi-empirical stage—would have imposed upon them.

#### EVOLUTION THROUGH WIND INSTRUMENTS.

It is time that writers on the evolution of music, and those interested in questions of intonation and harmony, should recognise the part that wind instruments have played in the development of musical systems, and how the theory of natural intonation arises out of the harmonic basis of music; that is the basis provided by the harmonic law implied in the physical constitution of sound and in the phenomenon of resonance.

#### POTENTIALITIES FOR PROGRESSIVE MUSICIANS.

What is the exact value to us in the 20th century of all these discoveries concerning the music of antiquity and the established realities of natural intonation? Simply this: it is the dawn of the music of the Future which has been felt and heralded by the modern French and Russian Schools amongst others. The whole-tone scale and its harmonies are transition stages on the way back to natural intonation. A small band of enthusiasts is already busy testing and using this new-old material provided by Nature. The violin and viol families, instruments with plucked strings, the oboe family, flutes of a certain kind, natural horns, trumpets, and trombones are all adaptable.

In a book now in preparation, which is being written in collaboration with the composer Elsie Hamilton, the theory and practice of music in natural intonation, with its amazing wealth of melodic and harmonic material, will be submitted for the consideration of progressive musicians.

The infinite possibilities of harmony in natural intonation will afford scope and stimulus for the creative musician; every Tropos is a mine of wealth, bearing its own characteristic hall-mark. Some of this new material can, indeed, be made available for keyboard instruments by a method of approximation which possesses the advantage of enriching the resources of the material at command and of suggesting new methods for the expression of ideas in music.