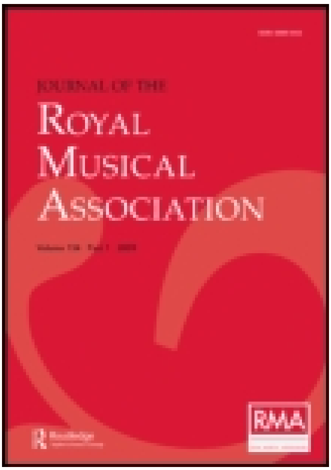

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On Some Points in the Harmony of Perfect Consonances

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ON SOME POINTS IN THE HARMONY OF PERFECT CONSONANCES.

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The study of Harmony is the study of the combinations or chords which are formed from musical notes.

The Harmony of Perfect Consonances is the study of combinations or chords formed from notes which have been constructed by tuning perfect consonances.

In the last edition of Dr. Stainer's excellent work on Harmony, he says in the preface that he believes his theory will be found perfectly applicable to the system of just intonation. This may be so, but yet there are many points in the harmony of perfect consonances which are not covered by the discussions in Dr. Stainer's book, nor are they dealt with in any other book with which I am acquainted, except Helmholtz. I propose to call the attention of the Association to a few of these points, which certainly will be fundamental in any treatment of the harmony of perfect consonances that may eventually be undertaken.

As there is great tendency to mix up and confuse the different portions of the subject of improved intonation, I must point out the limits of that portion on which we are engaged to-day; and for this purpose I may usefully refer to the second reason given by Dr. Stainer for omitting reference to the Tempered Scale, which is 'Because the attitude of scientific men to modern chromatic music has ceased to be that of hostility, inasmuch as they see that their system will never be adopted as long as it threatens the existence of a single masterpiece in musical literature, while, on the other hand, it will be universally accepted when it renders such works capable of more perfect performance.'

I may say, by the way, that I never heard of any scientific man, practically acquainted with the subject, who was hostile to modern chromatic music, or to masterpieces of any kind; and I cannot help thinking that it was the quite unfounded notion that this was the case, which gave rise to the feeling that recent musicians have undoubtedly had against the study of the various methods of tuning.

The division of the subject to which I above referred consists mainly in the distinction between the so-called mean tone system and systems based on perfect consonances. For the details of the mean tone system I must refer to my book on Temperament. It is enough here to say that the mean tone system adapts itself to existing music: in fact, it was the musical language of Handel and others of our greatest composers; and by the application of my keyboard its performance has been rendered perfectly easy, so that the challenge in the passage from Dr. Stainer is taken up.

But our business to-day will be with an entirely different class of systems. Though to some extent applicable to existing music, it is to the future that we must look for the real development of perfect consonances; and it is partly in hope of endeavouring to interest rising composers in this new and beautiful material that I am calling your attention to it to-day.

Almost all recent writers state that whenever harmony has been practised the chords have been made up by combining certain sounds of the scale at that time in use.

As far, however, as my studies have carried me, there is no instance until quite recently in which even a theoretical writer has derived his chords in this way; nor is there any historical authority for the statement that they ever were actually so derived. Crotch and all the older writers derive the scales from the chords. It is only necessary to think of the processes by which instruments are actually tuned, to see that in fact scales are derived from chords, not chords from scales. In fact, I have little doubt that scales and modern tonality arose from the tuning of the harps or lutes of minstrels by consonances. The earliest ancient music depended on the lyre, whose notes were unquestionably determined by tuning consonances.

I come down at once to Crotch. He treats concords as the foundation of everything. He was thoroughly grounded in the knowledge of just intonation. I have had occasion recently to read his works with some care. My opinion is that he was greatly in advance of his time, and that in many points we should do well to go back to his careful, accurate, and logical treatment, as the surest foundation available. The following table is taken, with very slight modifications, from Crotch's Elements of Composition; it is an extremely simple and powerful mode of exhibiting many of the relations to which I shall have to call your attention. It is substantially the same in principle with, and but little different in detail from, the method recently published by Mr. Ellis under the name of 'Duodenes':—

CROTCH'S TABLE OF RELATIONS OF INTERVALS.

Reprinted, with slight alterations, from Dr. Crotch's Elements of Musical Composition, p. 4. Novello's Edition.

'The middle row consists of key notes, the upper row of major thirds to those notes, and the lower of minor thirds to them. . . . . .

'Thus a major triad is any note with its major third and fifth, as ╲E over C—G, and a minor triad is thus expressed, C—G over ╱E♭ . . . . .

'Though the same letter is found in each of the three lines of the table (as ╲C in the upper line, the third to A♭, C in the middle line the key note, and ╱C in the lower line, the minor third to key note A), yet none of the notes contained in the one line are the same as those contained in either of the others, but differ from them in a slight degree, as the student will perceive when he comes to study tuning.'

Introducing my notation (╲, ╱) to denote the difference indicated by Crotch between notes of the same name in different lines, and shifting the lower line one place so as to obtain similar forms for the same intervals throughout the table, it assumes the following form:—

╲B♭ — ╲F — ╲C — ╲G — ╲D — ╲A — ╲E — ╲B — F♯ — C♯ — G♯ — D♯ — A♯ — E♯ — B♯ — F×

G♭ — D♭ — A♭ — E♭ — B♭ — F — C — G — D — A — E — B — ╱F♯ — ╱C♯ — ╱G♯ — ╱D♯

E♭♭ — B♭♭ — F♭ — C♭ — ╱G♭ — ╱D♭ — ╱A♭ — ╱E♭ — ╱B♭ — ╱F — ╱C — ╱G — ╱D — ╱A — ╱E — ╱B

Horizontal line — means an exact fifth. Vertical line | means a major third. Sloping dotted line ⋱ means a minor third.

I cannot hope to discuss any large number of chords to-day; and I propose to devote the time chiefly to chords formed from a series of thirds. Helmholtz has discussed several cases of these chords, but he confines himself principally to such forms as are derived from the notes of the scale. I shall consider also cases in which it is desirable to depart from the so-called notes of the diatonic scale.

Helmholtz enumerates first the different kinds of thirds, fourths, and fifths; these are the elements of our chords; we may reduce them to a small number of elements, from which the rest are derived by inversion and combination.

Perfect third	$c - \backslash e$
Pythagorean third (a comma sharp) .	$c - e$
Perfect fifth	$c -$
Fifth mistuned a comma . . .	$d - \backslash a$

To which we may add, as of occasional occurrence—

A third two commas sharp	$c - / e$
A depressed minor seventh . . .	$c - \backslash b$

The minor thirds, augmented fourths, diminished fifths, and other intervals are generally determined by combinations of the above. These above enumerated are intervals which arise more or less directly from tuning; and it is to the tuning of the notes of a chord that I desire to refer its consideration.

For the way in which differences of a comma arise in actual tuning of fifths and thirds, refer to Crotch's table, and see by what processes you would pass, say from $\backslash A$ to A.

I proceed to consider the chords formed by a series of thirds on the dominant.

The common chord of the dominant is—

$$g - \backslash b - d$$

I call your attention to the following variations of it.

The equal temperament chord.

The chord $g - b - d$ with Pythagorean third.

The chord $g - \backslash b - \backslash d$ with depressed second of the key and false fifth.

[These chords were played on an ordinary harmonium, and the large enharmonic harmonium from South Kensington, with which the examples of just intonation were illustrated.]

The object of calling attention to these modifications is this: in subsequent chords we may be confronted with these as alternatives, and it is desirable to know what the effect would be if we were to adopt them. We conclude that the fifth false by a comma is quite inadmissible, and the Pythagorean third only less objectionable than the false fifth.

Add the minor seventh*—

$$g - \backslash b - d - f$$

This f is derived by tuning two-fifths from g; it represents the ordinary minor seventh, and is very rough.

Depress the f a comma—

$$g - \backslash b - d - \backslash f$$

This chord is nearly smooth, it is approximately the consonance of the harmonic seventh.

Raise the first f a comma—

$$g - \backslash b - d - /f$$

This is the chord of the seventh according to some of the old theorists, who made the $/f$ a minor third $(6:5)$ to the d; it is disagreeable, as you hear.

Add the ninth to g; then, varying the seventh and ninth, we get the chords—

(1) $g - \backslash b - d - f - \backslash a$
(2) $g - \backslash b - d - f - a$
(3) $g - \backslash b - \backslash d - f - \backslash a$
(4) $g - \backslash b - d - /f - a$
(5) $g - \backslash b - d - \backslash f - a$

(1) Is the chord given by Helmholtz; it follows from selecting the notes of the diatonic scale; that is, the $\backslash a$ is made the major third to f.

But if I play this chord it sounds abominable. We perceive at once that this $\backslash a$ makes a false fifth with d, which is quite intolerable. We will now raise the $\backslash a$ to a, so as to make the fifth with d perfect, at the cost of the Pythagorean third $f - a$.

(2) Is thus obtained; it is still rough; we trace the roughness to the seventh $g—f$, and the sharp third $f—a$.

(3) Here we try depressing the d to $\backslash d$, which forms a fifth with the $\backslash a$, but we introduce the false fifth $g - \backslash d$, which is inadmissible.

(4) Here we raise the a, so that the fifths are both perfect, and raise the f to $/f$, so that it makes a perfect third with a. The bad seventh is the only dissonance, but it is very bad.

(5) Here we still have both fifths perfect, and give the seventh its smoothest position $\backslash f$, sacrificing the third, which is now two commas sharp. This is to my ear by far the most tolerable position of the chord, indeed the only one that is at all tolerable.

Helmholtz treats the employment of the fifth $d - \backslash a$ in these cases as correct; I can only say that if such combinations

* Reference should be made to Crotch's Table at p. 147, to see what the relations of the different notes are to one another with respect to tuning.

are to be used I had rather stick to equal temperament, which involves nothing so bad.

It is not necessarily the case that inversions or derivatives of a chord are best taken in the same way as the chord itself; it frequently happens that the relative importance of the different notes is entirely changed, so far as the preservation of harmoniousness is concerned. For instance, in the dominant seventh, if the seventh is in the bass,

$$f - g - \diagdown b - d$$

No appreciable increase of smoothness is obtained by depressing the f to $\diagdown f$.

Some theorists say, what is the use of seeking for the smoothest forms of combinations? The ear likes dissonances. I say that if we are to use these chords, their smoothness or roughness is their principal characteristic, and deserves to be examined.

The statement that the ear likes dissonances I meet in this way. I do not believe that any healthy ear likes such dissonances as are produced by mistuning any consonance one or more commas. The dissonances in ordinary use, which deviate from consonances by not less than a semitone, are of quite a different character, and have nothing of the horrible sharpness of consonances mistuned by one or two commas. These last dissonances are audible through any quantity of the others, and I lay it down as a practical rule, that forms are to be preferred in which dissonances of mistuning, as I call them, are least offensive.

I will now consider one or two cases in which freedom is gained by the omission of a link of the chain of notes which constitutes the complete chord of the ninth. We have seen that the whole chain cannot be put together without the occurrence of dissonances.

Omission of the Fundamental g.

This permits us to depress the second of the key, so as to form a fifth with the sixth, $\diagdown d - \diagdown a$. The chord then becomes

$$\diagdown b - \diagdown d - f - \diagdown a$$

The combination $\diagdown b - \diagdown d - f$ still possesses some roughness. We have passed over the study of the forms of the dissonant triad, which should precede that of these chords, and does precede them in Helmholtz; but we can admit that

$$\diagdown b - d - \diagdown f,$$

part of the complete chord of the harmonic seventh, is the smoothest form, and

$$b - d - f,$$

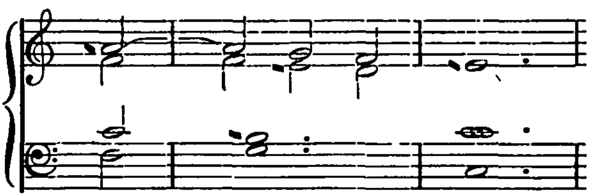
which is most like the chord in ordinary use, is of medium quality.

In a passage like the following,

we have the first form above mentioned, i.e. that derived from the scale; it cannot here be modified in any way, since the first chord determines the f and $\searrow a$, and the $\searrow d$ in the second chord is determined by the suspended $\searrow a$.

Where the chord is struck without suspension any form not dissonant of itself may be used.

We have above an example of the constraining effect of suspension; consider now a succession similar to the above, with introduction of the complete chord of the ninth on the dominant; the difficulties thus arising are nearly as great as in any case I know.



If we try to introduce the second of the key in the second chord, it forms a chain of fifths between the dominant and sixth of the key; the one requires it to be d, the other $\searrow d$; it is therefore impossible to introduce the complete chord of the ninth on the dominant when the ninth is suspended as the sixth of the diatonic scale.

Consider next the chord formerly called the 'added sixth,' now usually derived as a chord of the seventh on the supertonic.

$$d - f - \searrow a - c$$

The above would be this chord according to the notes of the diatonic scale, but this is inadmissible on account of the false fifth $d - \searrow a$. It has been usual to avoid this by depressing the second of the key thus,

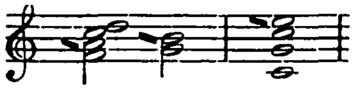
$$\searrow d - f - \searrow a - c$$

or, considering the chord in the position which gave rise to the name 'added sixth,'

$$f - \searrow a - c - \searrow d$$

in this form the chord presents itself as an agglomeration of consonances, containing only the mild dissonance of the whole tone. Its resolution in this form, with suspension of the second of the key, presents, however, almost insuperable difficulties.

This is the only strict way of effecting the resolution. But it involves a drop of the whole pitch by a comma, which has generally a very disagreeable effect. No resolution depending on a false fifth can, in my opinion, be tolerated, though I am bound to say that Helmholtz takes a different view. He would write the passage,



As before, I say that I would rather stick to equal temperament than face such sounds as these.

If it is really required to employ such passages in connection with perfect consonances, it is in my opinion generally best to sacrifice the thirds, i.e. in the above passage the third $f — \backslash a$ would be changed into the Pythagorean third $f — a$. But nothing is gained by the employment of perfect consonances where such expedients have to be resorted to.

I have endeavoured so far to point out some of the principal difficulties in the harmony of perfect consonances. The best way for the composer to deal with these points will be to avoid them.

Successions of minor thirds admit of easy treatment; the minor third is not an interval susceptible of accurate tuning, and chords containing minor thirds may be arranged in almost any manner; the following are usual forms :—

Augmented Sixth.

The use of this by the older composers, especially Mozart, is so effective in just intonation that I am unable to believe that this was not within their view.

Referring to Crotch's Table, we easily see that the augmented sixth $/A\flat — F\sharp$ may be represented as an octave less two diatonic semitones (corner to corner, *across* the dotted lines, is a diatonic semitone or a major seventh).

In ratios, two diatonic semitones make $\left(\frac{16}{15}\right)^2 = \frac{256}{225}$ and an octave less two diatonic semitones is $2 \div \frac{256}{225} = \frac{225}{128}$. But the ratio $\frac{7}{4} = \frac{224}{128}$. Whence—