

Modern Systems of Harmony

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THE MUSICAL TIMES

AND SINGING-CLASS CIRCULAR.

FEBRUARY 1, 1880.

MODERN SYSTEMS OF HARMONY.

By JAMES LECKY.

IN Dr. Grove's "Dictionary of Music and Musicians," now in course of publication, there is an interesting notice by Mr. Hubert Parry of Dr. Alfred Day, author of a treatise on harmony. Mr. Parry gives a clear and accurate analysis of this work, and speaks of it in terms of high praise. "The principle which throughout characterises his system is to get behind the mere shallow statement of rules and exceptions to the underlying basis from which exceptions and rules will alike follow." And again: "Whatever may be said of its hypothetical and as yet incompletely substantiated views, it must be confessed that no other theory yet proposed can rival it in consistency and comprehensiveness. The strong adhesion given to it by one of our most distinguished living musicians, the Professor of Music at Cambridge, should be sufficient to recommend it."

Though approved by such high authority, this system has not escaped serious opposition. One of its chief features, the distinction between artificial and fundamental discords, has been severely dealt with by Dr. Stainer in his treatise on harmony; and at a meeting of the Musical Association, on February 1, 1875, Mr. C. E. Stephens exposed some of its fallacies with vigour and success. It will therefore be interesting to inquire what is the actual value of this system, which has now been before the world for thirty-four years, and is still a subject of dispute among musicians.

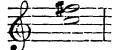
At the outset we must ask to what intonation does Day's theory apply? Such a question seems never to have occurred to Day himself, and in his work there is some confusion on the point. Thus he defines each musical interval as consisting of so many semitones, which can only apply to equal temperament, for in any other system there are two or more different kinds of semitone. Again, he often discusses whether a note should be written D \sharp or E \flat , a distinction which is practically important only when these symbols represent different sounds, as in the mean-tone system. Moreover, he describes the scale as derived from three conjunct triads, as F A C, C E G, G B D, which is true only in just intonation.

It is evidently absurd to found our theory on one system of tuning and our practice on another. The equal temperament is now in such general use that theorists are perfectly justified in taking it for their basis, as Dr. Stainer and others have done. The mechanic simplicity of this temperament has driven out of use other systems which are far more harmonious, but which require a larger number of notes to the octave. Thus, the mean-tone system, which was used, though in an incomplete, restricted form, from the time of Palestrina to that of Handel and Bach, requires at least twenty-four notes to the octave. The practical use of this and other enharmonic systems has been made possible for the first time by the generalised keyboard recently invented by Mr. Bosanquet. He has also clearly shown that certain chords and progressions, which sound well in equal temperament, are unendurable in just intonation; and he has made valuable suggestions as to the treatment suitable to the improved systems of tuning.*

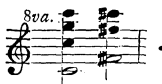
* See "Elementary Treatise on Musical Intervals and Temperament," by R. H. M. Bosanquet.

Day knew nothing of this, and his work is applicable only to the mean-tone system or to equal temperament.

Day's definitions of chords and scales are merely formal. He tells us how to find the various intervals on the keyboard, but he does not attempt to explain how these intervals are obtained. He divides chords into consonant and dissonant, but does not say in what consonance and dissonance consist. This is not surprising, for the true explanation of the affinity of sounds, of consonance and of dissonance, was unknown till seventeen years after Day wrote. Seventeen more years have elapsed since Helmholtz's discoveries were published, but they appear to be still unknown to the writers of musical text-books. We find, instead, strange speculations, either contrary to observation or outside the reach of observation altogether. Thus, in Dr. Stainer's treatise we read: "If any interval smaller than a third be heard, it requires to be adjusted to a third before the ear is satisfied. This unsatisfactory effect of an interval smaller than a third is termed discordant." But there are many discords to which this does not apply, and Dr. Stainer accounts for them thus: "The discordant interval may

be implied or expressed. Thus  contains

no interval less than a third, but as the note D is implied it is a discord." But the note D is not there at all, and cannot affect our ears in any way. The theory of "implied notes" is no explanation, for dissonance is a sensible fact, and must therefore have a sensible cause. The true explanation is that C-F \sharp beats like any other dissonance, the 3rd and 4th partials of C interfering with the 2nd and 3rd

partials of F \sharp respectively, thus: .

Day attempts to give a theory of only one class of chords, which he calls "fundamental, because every harmony springs from one of three certain roots or fundamentals, and can only be taken on certain notes of the key. By root or fundamental is meant that note, being a diatonic note of the scale, which will amongst its harmonics first produce the notes of which any chord is composed" (p. 54). Day uses the word "harmonics" in two senses; first, to signify a series of musical notes whose vibration numbers are as 1, 2, 3, 4, 5, 6, 7, &c.: second, to signify the series of simple partial tones of which an ordinary musical sound is composed. This ambiguous use of the word is also found in some recent writers.

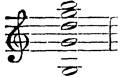
The list of harmonics which Day gives on p. 51 is erroneous. "The harmonics from any given note [say G] (without taking the order in which they arise but their practical use) are, major third [B], perfect fifth [D], minor seventh [F], minor or major ninth, [A \flat or A \sharp], eleventh [C], and minor or major thirteenth" [E \flat or E \sharp]. There can be no doubt as to the notes Day means, for on p. 107 he directs F-C, C-G, G-D to be tuned as fifths, and A \flat -C, E \flat -G, C-E, G-B as major thirds, adding that "the intervals are not to be tempered; that is, they are to be tuned quite perfect, without a beat."

It is easy to show that neither C, nor E \flat , nor A \flat , nor E, nor F, when thus obtained, can ever be harmonics of G. The note A is not defined, so that he may have meant the fifth of D or the third of F. The remaining notes in Day's list, D and B, are only harmonics of G when taken as twelfth and seventeenth of the bass respectively.

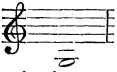
The error of Day's system is, that he disregards the partial tones of all the notes in the chord, except

of that note which he calls the root.* Hence he cannot explain the minor third, major third, fourth, fifth, minor sixth or major sixth, for none of these are harmonics. He acknowledges this with regard to the minor third, and he calls it therefore "an arbitrary, not a natural third" (p. 54). Yet it is as easy to explain the minor third as any other consonance; the 6th partial of G is identical with the 5th partial of B♭. The error we have pointed out is by no means peculiar to Day; it is found in Rameau, and in nearly all theorists before Helmholtz. Even now it is constantly repeated by writers who have better opportunities of learning the truth than had Rameau or Day.

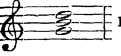
The definition of a root which Day gives is inapplicable to a great number of musical chords. It is

true that in a chord of this form  the bass

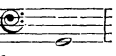
note stands to the other notes of the chord in the same relation as the prime stands to the upper

partial tones of the compound note . But,

in chords of any other form, the theorist is compelled to fall back on the notion of implied or imaginary

roots. Thus in the major triad  no note is

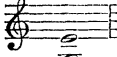
a harmonic of either of the other two. It is true that both G-B and B-D produce the difference

tone , but this is a *simple* tone, and there-


fore does not stand in the relation of a *compound* tone to its harmonics, as was the case in the first chord.

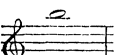
Again, the minor triad  can have no root

according to Day's definition, for B♭ is no harmonic of G nor of D, and G is no harmonic of B♭ nor of D. If the rule will not apply to the consonant triads we need not test it with regard to dissonances. No doubt Day took his theory from Rameau; but Rameau's system, though a great advance on all previous ones, is now completely superseded by the researches of Helmholtz. The relation between two

notes such as , was formerly supposed

to consist in their both being harmonics of

; it is now shown to consist in their both

possessing the same partial tone .

When stripped of its pretended science, Day's theory reduces itself to a series of thirds taken from the scale. Thus the notes he derives from G, namely, B, D, F, A♭, A, C, E♭ and E, may be separated into two chords, G-B-D-F-A-C-E and G-B-D-F-A♭-C-E♭, the former taken from the major scale of C, the latter from the minor. Dr. Stainer has recently developed this method further by building up a series of thirds on the tonic, by which means he gets C-E-G-B-D-F-A and C-E♭-G-B-D-F-A♭. The first note of each of these chords Dr. Stainer considers to be the root. He fails, however, to show that the ear perceives any peculiar character or function in this root, which would distinguish it from all the other notes of the chord. Moreover, many chords

cannot be reconciled with this theory, except by supposing a large number of implied sounds. To take an extreme case, A♭-C-E♭-F♯ is explained by Day and by Dr. Stainer as derived from G-B-D-F-A♭ and D-F♯-A-C-E♭. But it is evident that the notes G, B, D, F and A, which are not in the chord at all, cannot affect our ears in any way. The method of treating a chord of few notes as part of a chord of many notes explains nothing, and has brought much confusion into musical theory. It is far more reasonable to treat every chord as consisting of as many pairs of notes as it contains. Thus A♭-C-E♭-F♯ consists of A♭-E♭, A♭-C, C-E♭, which are consonant, and of A♭-F♯, C-F♯, E♭-F♯, which are dissonant. This method is employed and justified by Dr. Pole in his recent work on the "Philosophy of Music."

Day did not try to give any theory of "diatonic dissonances": he called them artificial and unnatural (p. 51). Yet the explanation of the affinity of sounds, of consonance and of dissonance, applies to all kinds of chords equally. The so-called fundamental chords are not more natural nor less artificial than any others, and the distinction on which Day insists, that diatonic discords must be prepared while fundamental need not, has been shown by Dr. Stainer to be groundless.

A formidable list might be made of the chords which Day forbids, but we shall only notice one of these, the augmented fifth on the dominant. Mr. Parry says that Day "brought to bear both mathematics and practical experiment to prove" that this chord cannot be used; and Professor Macfarren refers to his arguments as "unanswerable." The "mathematics" are merely some simple arithmetic. He says (pp. 105-6): "It is not generally known that a diatonic semitone, as it is called, is really larger than a chromatic one, which is the case; therefore E♭ is sharper than D♯, as the following will prove. Take any given note, say C, as 1, the ratio of the octave is 2, that of the fifth 3/2, *ergo* that of the fourth 4/3; the ratio of the major third is 5/4, *ergo* of the minor sixth 8/5, and of the minor third 5/6."


D♯ of B of G = 3/2; octave below = 3/4. E♭ 4/3.

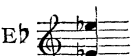
Reduce 3/2 and 3/4 to common denominator.

5 × 75 = 375. 64 × 6 = 384. 75 × 6 = 450.
3/2 = 375/250 = 3/2 = 3/2 = 3/2 = 1/2 (the ratio of the octave); = 3/2; *ergo*, E♭ is 1/2 of an octave sharper than D♯."

It is evident that this passage teems with errors. If C be 1, then G is 3/2 not 3, and all the other numbers are wrong in the same way. It is true that C is to D♯ as 64 to 75, and the same C to E♭ as 5 to 6. But by multiplying 6 by 75 Day identifies E♭ and D♯ and gets two different Cs. Again, it is absurd to bring the two fractions to a common denominator and subtract; he should have divided one by the other. What 3/2 means here we cannot say, but the minus sign which follows is no doubt a misprint for the sign of division. It is absurd to divide an interval by 1/2 to find how often it goes into an octave. He should have found to what power the improper fraction representing the interval between E♭ and D♯ must be raised to equal 2.

The interval between E♭ and D♯ may be found much more simply thus. Tune 3 major thirds up

from E♭  and also an octave up from

E♭ . We hear that E♭ is the higher sound,

and we see by calculation that it must be so. Three major thirds = 3/4 × 3/4 × 3/4 = 27/64, and an octave = 2. Then 2 ÷ 27/64 = 128/27. Therefore E♭ is sharper than

* This was first pointed out by Mr. Bosanquet ("Proceedings of the Musical Association," 1874-5, p. 125).

D \sharp by $\frac{128}{125}$. To avoid tediousness we will use logarithms to find how often this interval goes into an octave. The log. of $\frac{128}{125}$ is .01030, and the log. of 2 is .30103 and the quotient is 29.2. . . . Hence E \flat is sharper than D \sharp by nearly $\frac{1}{29}$ of an octave, or nearly $\frac{1}{3}$ of a major tone.

But this is evidently no reason why we may not use D \sharp as augmented fifth on the dominant G. "To those to whom the above" [his mathematics] "may be unsatisfactory or unintelligible," Day recommends a practical experiment. The following chords are to be tuned in just intonation:



and Day thinks that "the mere sound will, independently of all reasoning, set the question at rest (at least with the hearers) for ever, and put it beyond a doubt that no augmented fifth can be taken on the dominant."

The question has however not been set at rest, and Day's argument will not bear out his conclusion. The chord G-B-F-A \flat -D \sharp does indeed produce a horrible and unmusical effect; but this is due to the false interval or "wolf" A \flat -D \sharp . Leave out the A \flat , and G-B-F-D \sharp sounds perfectly well. Day would no doubt maintain that, whether A \flat be heard or not, it is implied in the chord G-B-F-D \sharp ; but on this as on so many other points his views may be regarded as obsolete. The chord G-B-F-E \flat also resolves perfectly well on C-E \flat , and in melody D, E \flat , E \sharp , has perhaps a better effect than D, D \sharp , E.

The pitches which Day assigns to D \sharp and E \flat are not the only ones possible in just intonation. If we take D \sharp to mean 8 fifths up (or fourths down) from G, we get a note almost identical with E \flat , the major third below G. The ordinary notation is very ambiguous when applied to just intonation; additional signs have therefore to be used to indicate the exact sound intended.* The ordinary notation corresponds perfectly to the mean-tone system of temperament, in which the fifth is tuned flat, but the major third just. In this system there is but one D \sharp and one E \flat , and the latter is sharper than the former by nearly $\frac{1}{29}$ of an octave. So long as this system was in general use, errors of notation could hardly occur, for they would mean errors of pitch. At present, musicians are for the most part unacquainted with any intonation but equal temperament, and errors of notation are therefore constantly found.

Day asks, "What possible sense could be made of" this chord G-B-F-D \sharp ? The chord is satisfactory in practice, and if it will not fit in with his theory, so much the worse for the theory. We touch here the radical difference between Day's view of musical science and that which now prevails. He tries to deduce from abstract principles what music ought to be: anything he cannot reconcile with those principles he denounces as arbitrary and unnatural. Perhaps that is the best thing he could do under the circumstances. Let us rather take as music what the ear judges to be such, and demand from science an explanation of the ear's decision. There are indeed many rules in music which science cannot explain, but which are justified by experience.

We are therefore unable to join Mr. Parry in the eulogy quoted at the beginning of this article, for we think that Dr. Day misrepresented the natural facts

on which he professed to base his system, that his classification of chords is unnatural and impossible, and that he did not understand the nature of the problems which music offers to science. The theoretic part of his system is valueless, and the practical part has long been superseded by more musicianlike works.

Yet it must be acknowledged that Day appears to advantage beside many of his rival theorists. He is beset by no strange delusions about "chromatic alteration" or "negative harmonics"; and he keeps clear of the Serbonian bog of ancient and mediæval music in which so many have lost themselves. His examples of chords and resolutions are very numerous, and many of them might occur in music. Lastly, his style is so clear and straightforward that his errors become doubly evident, and we are therefore the more surprised to find them still so widely accepted.

CHORAL ASSOCIATION.

By J. POWELL METCALFE.

(Concluded from page 11.)

WE will now suppose that the secretary has ascertained what choirs within the district he proposes to occupy are willing to associate—having given all the option of so doing—and that all have been supplied with the number of copies of music they require, being not less than the number of singers they propose to bring to the festival, and that these copies have been paid for on receipt for the ease of the account-keeping; that the three—or more if thought advisable—rehearsals of the home teachers, with such clergy, ladies, and others as can be got to attend, have been duly held at convenient centres and on fitting days (generally, for the convenience of the schoolmasters, Saturdays, morning or afternoon); and that time has been given for the instruction imparted at these rehearsals by the precentor to be passed on to the choirs.

The precise day of the festival will now have to be fixed, in due regard to local market-days and the like—as a rule, within the two or three weeks preceding hay-time and the two or three weeks intervening between the end of hay-time and the beginning of harvest; and the rehearsals of the choirs in groups will now commence. Care should be taken that these rehearsals do not degenerate into mere lessons at which the precentor will be expected to do the work that the home teacher ought to have done: it is not his place to teach the right notes, or that this is a natural and not a sharp; all that should be done before he comes. It will help to check this if a rigid rule be made that the rehearsals be attended by three choirs at least; and as the attendance at two rehearsals only will probably suffice, this rule cannot be considered too hard, unless the distances apart are unusually large.

If possible, let it be arranged that the organist of the church in which it is settled to hold the festival—which, except in very unusual cases, will be that of one of the associated choirs—accompany at each of these rehearsals; and by no means, without special cause, let him be displaced from his organ-stool on the festival-day. It will be quite time enough to find a strange organist when the proper one displays an antagonism that won't be worked with, or—a very much more likely thing—modestly shrinks from assuming responsibilities in mistrust of his powers.

Except in those churches where that most common-sense arrangement has been adopted of carrying the organ-trackers across to the opposite side, so that the organist, instead of being boxed up among his pipes, is so removed as to be able to hear

* See Stainer and Barrett's "Dictionary of Musical Terms," p. 425.