



I. On the two Systems of Musical Temperament recommended by Earl Stanhope,—Mr. Hawkes's System

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THE
PHILOSOPHICAL MAGAZINE.

- I. *On the two Systems of Musical Temperament recommended by Earl Stanhope,—Mr. Hawkes's System, &c.*
By Mr. JOHN FAREY.

To Mr. Tilloch.

SIR,
H^AVING bestowed some pains to illustrate the System of Musical Temperament described by Earl Stanhope in your xxvth volume, as applicable to keyed Instruments, by the help of a *Monochord*, whose divisions are according to geometric mean *proportionals*, I beg now to present to your readers, the notes of the other System, described by his Lordship in the same Essay, to be effected by making three successive tempered *Fifths*, and two successive major *Thirds*, in different parts of the scale, *beat equally quick* respectively.

The table accompanying this, is divided into 10 columns, entitled at the bottom, as has usually been done.

Column 4 contains the number of complete vibrations made by a musical string or other sounding body in one second of time, when the intervals are agreeable to Earl Stanhope's *Monochord System*; whose logarithms, lengths of strings, and other particulars for comparison herewith, will be found vol. xxvii. p. 195 *, and vol. xxviii. p. 141.

* I beg here to correct an unfortunate error in the length of string which I have in this page assigned to Lord Stanhope's 6th, owing to my having taken out the number answering to the logarithm .8100300 (instead of .8010300) viz. .6456987 instead of .6324554; for which correction I wish to acknowledge my obligation to Mr. J. Barraud, a gentleman engaged in these inquiries, who has verified the numbers in this column, except in some of their last places, independent of the logarithms in the preceding column.

Columns 5, 6, 7, 8, and 9, are intended to explain the *Equal-beating* System of his Lordship (see vol. xxv. pp. 301, 302; xxvii. p. 203; and xxviii. p. 150): the 5th contains the complete vibrations (which Earl S. would call *Beats*) made in one second of time; wherein 240 is assumed as the *pitch* of C on the Tenor Cliff line (a ledger line below the Treble, or the same above the Bass stave in music), on the authorities quoted in the article *Concert pitch*, in vol. ix. part I. of *Dr. Rees's New Cyclopædia*, lately published.

I am aware that Earl Stanhope, (vol. xxv. p. 303,) refers, in his Tuning Table, to the Octave below my C instead of above it, at least for tuning of some of his notes, but I have preferred this Octave, and added to my calculation, vol. xxvii. p. 203; extending the same to the *equally beating* THIRDS in this his Lordship's System.

If the Third E bA in his Lordship's Table be tempered sharp 1.066 commas, and the Third bAc, also sharp .843 parts of a comma, both of these will *beat* 10.00 times per second; and his three successive Fifths GD, DA and Ae, if tempered flat .4721, .3163 and .2116 parts of a comma respectively, will each be found to *beat* 3.158 times per second nearly. The half of the number of *Vibrations* in columns 4 or 5, or of *Beats* in this Octave, will answer to the first Bass Octave, and twice these numbers to the first Treble Octave respectively; and the half or double of these again, will express the next descending or ascending Octave respectively, and so on, throughout the whole scale.

Columns 6 and 7 contain the logarithms and lengths of strings in this System, for comparison with the notes in his Lordship's *Monochord* System, vol. xxvii. p. 195; as column 8 is intended, to compare with vol. xxviii. p. 141; in which column, I have preserved the terms f and m, the same, and thrown all the differences between this and the monochord system, into the term Σ , as the same are expressed in column 9: from whence it appears, that half the notes differ more than $1\frac{1}{4}$ *Schismas* from each other respectively, in these two Stanhopian Systems,

A Table

A Table shewing the Relations which the several Notes in an Octave, above the Tenor Cliff C, bear to the Key Note, when tuned according to the EQUAL-BEATING System of Earl Stanhope; with the Notes of Mr. Hawkes's System, for Comparison therewith.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
12	c	VIII	480-00	480-00	•6989700	•5000000	612-0000 Σ + 12 f + 53 m	612 Σ + 12 f + 53 m	
11	B	VII	450-00	450-00	•7269987	•5833333	555-0000 Σ + 11 f + 48 m	555 Σ + 11 f + 48 m	
10	^b B	7th	426-67	426-67	•7501225	•5625	508-0000 Σ + 10 f + 44 m	512 Σ + 10 f + 44 m	
9	A	VI	401-66	401-05	•7770106	•5984961	453-3248 Σ + 9 f + 39 $\frac{1}{2}$ m	455 Σ + 9 f + 39 $\frac{1}{2}$ m	
8	^a A	6th	379-47	380-02	•8004063	•6315480	403-7725 Σ + 8 f + 35 m	400 Σ + 8 f + 34 m	
7	G	V	360-00	360-00	•8239087	•6666666	358-0000 Σ + 7 f + 31 m	355 Σ + 7 f + 30 $\frac{1}{2}$ m	
6	^b G	IV	337-31	337-79	•8513589	•7104915	301-7725 Σ + 6 f + 26 m	298 Σ + 6 f + 25 $\frac{1}{2}$ m	
5	F	4th	320-00	320-00	•8750613	•75	254-0000 Σ + 5 f + 22 m	256 Σ + 5 f + 22 $\frac{1}{2}$ m	
4	E	III	300-00	300-00	•9030900	•8	197-0000 Σ + 4 f + 17 m	199 Σ + 4 f + 17 $\frac{1}{2}$ m	
3	^b E	3d	284-00	285-01	•9253450	•8490638	151-7725 Σ + 3 f + 13 m	154 Σ + 3 f + 13 $\frac{1}{2}$ m	
2	D	II	268-88	268-42	•9513944	•8941170	98-9726 Σ + 2 f + 8 $\frac{1}{2}$ m	99 Σ + 2 f + 8 $\frac{1}{2}$ m	
1	^a D	2d	252-98	253-35	•9764976	•9473220	47-7725 Σ + f + 4 m	42 Σ + f + 4 $\frac{1}{2}$ m	
	C	Key	240-00	240-00	1-0000000	1-0000000			
Intervals in half notes.	Letters of finger-key.	Marks.	Vibrations in 1" by Earl Stanhope's Monochord System.	Vibrations in 1"	Common Logarithms.	Lengths of Strings.	New Notation.	Differences from his Monochord System.	Mr. Hawkes's System, in New Notation.—See vol. xxvi. p. 173.

Since it appears, (vol. xxviii. p. 304,) that Mr. *William Hawkes* asserts the superiority of his System (vol. xxvi. p. 171,) over that of Earl Stanhope, as being "the best principle for tempering our present scale" with 12 notes in an octave, I have devoted a column of my present Table to his System, and whereby a comparison of the same may be made, with either of Earl Stanhope's Systems; and where the differences in *schismas* and *minutes*, between any of the respective notes in each, may be obtained by a very easy subtraction.

From such a comparison it will appear, that Earl Stanhope's notes some of them differ materially from Mr. Hawkes's corresponding ones, and that both of them differ much, comparatively, from the *Equal Temperament*, a mode of tuning, which Earl Stanhope says, (vol. xxv. p. 291,) was approved by one half of the most eminent musicians in England, whom his Lordship particularly consulted on the subject: although Mr. H. and his Lordship so cordially agree, (vol. xxviii. p. 305,) and (vol. xxv. p. 305,) in condemning the same.

In my last, I omitted to mention, respecting the *Isotonic* system in column 4, (vol. xxix. p. 347,) that if each note therein, all of which contain fractional parts of the very small interval m , be increased to the next *whole* number, as $48\frac{7}{8}$ to 49 m , $46\frac{1}{8}$ to 47 m , &c., these trifling alterations will reduce it to my *Equal Temperament*, mentioned vol. xxviii. p. 65, and the same can then be *practically tuned*, by the help of *perfect conchords* only! We may therefore now hope, that "*Equal Temperament*," which so many have commended, and others condemned, probably without having ever heard any music performed in it, will be brought to the test of experience, and practice sufficiently extensive, to get over the prejudice which will naturally arise, on the hearing of any new system whatever.

Many, I know, have imagined, that the system which was aimed at by the professional Tuners before Earl Stanhope wrote, was an *Equal Temperament*, to be effected by the judgment of the ear, and Mr. Hawkes thinks that their practical results agree very nearly with his system: both of these opinions I have much reason to doubt, and cannot refrain

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refrain from again endeavouring to call the attention of some gentleman, possessed of good Instruments and the necessary knowledge and experience in making experiments and calculations in harmonics, and requesting him to employ the best professional Tuners to tune his instruments, without any intimation to the Tuners, of his intentions or object; and before such instruments are put out of tune by use or standing, to ascertain exactly, by the *beats* of the different conchords, by a monochord; and by other methods also for further satisfaction, the exact value of every interval in an Octave, using single strings only: these experiments varied and repeated, on Organs and Piano-Fortes, tuned by as many good tuners as possible, would, by their results, enable us to say, how far any one system whatever has been adopted, or can be accomplished, by the method of tuning in use, and within what limits the different tuners, or the same persons at different times, do in practice fix each note. Such an one would doubtless perform the most valuable piece of service to the practical musician, and perhaps enable him to profit from the labours of theorists in harmonics, by enabling him with more certainty and facility, to accomplish the "tuning," with which by practice his auditors are become acquainted, and wherewith most of them are satisfied*, if the same did not lead to an amelioration of the system. With such information before them, the musical public would perhaps be enabled to judge, of the pretensions of the many musical quacks, who are almost every year bringing forth some new and fanciful system of temperament, (of which an almost inexhaustible fund yet lay behind,) and crying up the same with a confidence, equalled only by that with which rival empirics condemn them: until at length the *Science of Harmonics*, and the valuable discoveries of *Dr. Robert Smith* on the nature of *imperfect*

* Let it always be recollected, that performances on *perfect Instruments* or by voices, are free from defects in *harmony* if skill and good ears but direct them, and that the present inquiry is limited to the use of Instruments with 12 strings or pipes in an octave, where, or even with double that number of fixed sounds, temperaments, or errors in harmony are impossible to be avoided.

consonances, and of Mr. Maxwell on the system of perfect consonancy, are in danger of falling into utter contempt.

I beg here to mention, respecting the new notation for musical intervals, which I have explained vol. xxviii. p. 140, that the Octave, happening to contain just 12 of the *lesser fractions* f , and one of these to fall near each note of the equal temperament; in almost all calculations respecting *Douzeaves*, the temperaments or results, are free of f , and two only of the *three* independent or *prime* terms, of which every *accurate* notation must consist, are in general found at last; while the smallness of the most *minute*, m , it being less than the $\frac{1}{127}$ th part of the *Schisma*, Σ , which is itself but a very trifle more than $\frac{1}{11}$ th part of a *Comma*, c , (or $\frac{1}{11} \Sigma + \frac{1}{11} m$) render it allowable in most practical cases to neglect m , and to consider the Σ s as *elevenths* of a comma, in the results; although I would advise the previous calculations to be always carried on strictly, in Σ , f and m , especially, as the number of f s will generally point out, to what finger-key or number of half notes, any step in the process answers.

I am, sir, your obedient servant,

JOHN FAREY.

12, Upper Crown-Street, Westminster,
February 1, 1808.

II. *Essay upon Machines in General.* By M. CARNOT,
*Member of the French Institute, &c. &c.**

Preface.

ALTHOUGH the theory to be discussed be applicable to every subject which concerns the communication of motion, I have given to this work the title of *Essay upon Machines in General*;—in the first place, because it is principally machines I purpose to treat of, as being the most important

* For a Translation of Carnot's "Reflections on the Theory of the Infinitesimal Calculus," see *Phil. Mag.* vol. viii. p. 222, and 335; and vol. ix. p. 39.