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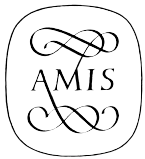

aimed at the musician and amateur piano tuner, this is not to say that a specialist would not benefit from it. But most of all it will serve well as an introduction to the skills required of piano tuner-technicians and as an avenue for musicians' understanding of the machine they control with their fingertips.

ANDRIS K. CHAPIN

Owen Jorgensen. *The Equal-beating Temperaments: A Handbook for Tuning Harpsichords and Forte-Pianos, with Tuning Techniques and Tables of Fifteen Historical Temperaments*. Raleigh, N.C.: The Sunbury Press, 1981. 36 pp. $4.50 (paperback).

Herbert Anton Kellner. *The Tuning of My Harpsichord*. Schriftenreihe Das Musikinstrument, vol. 18. Frankfurt am Main: Verlag Das Musikinstrument, 1980. 54 pp. DM22 (paperback).

It must be admitted at the outset by the reviewer that he expressed publicly the wish that expert piano tuner and authority on historical tunings Owen Jorgensen write a brief practical method on the historical keyboard tunings, based on his voluminous *Tuning the Historical Temperaments by Ear* (Marquette: The Northern Michigan University Press, 1977). This Jorgensen has now done in *The Equal-beating Temperaments*; but how regrettable that, aside from the excellent section on tuning techniques, which all early keyboardists should consult, the result cannot be recommended, least of all to the novice tuner. With the exception noted, the booklet is little more than a curiosity, mingling as it does so much misinformation and confusion with genuine information, and providing no way of distinguishing between them.

Jorgensen's thesis is that musicians of old tuned keyboard instruments by the equal-beating method, which is the determination of the pitch of a given note within a desired temperament by equalizing the beats of two specific intervals, both of which include the note in question. This method offers a very precise tuning tool that can aid in

tuning accuracy and consistency. But there are serious limitations, as for example:

1. Equal-beating intervals (e.g., major thirds) on different pitch levels do not sound equal in quality, as the author claims on page 8. If the word "quality" is to have meaning in this context, it needs to be defined in a useful and unambiguous way: when two intervals, such as our major thirds, are exactly the same size, they will be "identical in quality," to use Jorgensen's phrase. In that case, if they are anything other than absolutely pure, their beat speeds cannot be equal.
2. A pure third from *c'* to *e'* can be divided quite accurately with a *d'* placed by adjusting the thirds *b flat–d'* and *d'–f' sharp* / *g' flat* to beat equally, the *b flat* and *g' flat* having already been tuned in a series of pure fifths down from C, as Jorgensen does on pages 23 and 25 and elsewhere. It is another matter, however, to temper two common-tone fifths by equal beats. If one equalizes the beats of the fifth *d–a* and the fourth *d–g*, as Jorgensen does on page 16 and elsewhere, the result is a substantially poorer fifth *d–a* than the resulting fifth *G–d*. This may not make so much difference in the unequal temperaments (e.g., Kirnberger, Werckmeister), but it is quite unacceptable as a basis for tuning quarter-comma meantone, which requires a smooth array of tempered fifths, as nearly equal in size as possible.

Thus, in spite of its precision, the equal-beating method can give undesirably (and consistently) sloppy results; it is ironic that results closer to the theoretical ideal can be obtained in the second example above by adjusting the fourth *d–g* to beat "just a bit faster" (ideally one-third faster) than the fifth *d–a*, which is just as easy to do as equalizing the beat rate. This is certainly one reason that, although theorists presented vast arrays of mathematically precise temperaments and monochord divisions, actual practical tuning instructions (the few that history has left us[1]) tend to be quite vague and suggestive —for example, the instruction to tune "all Fifths as flat as the Ear will

1. For a discussion of such instructions, see George Sargent, "Eighteenth-Century Tuning Directions: Precise Intervallic Determination," *The Music Review* 30 (1969): 27–34.

permit" (Prelleur, *The Modern Musick-Master*, 1731). Reliance on a mechanical counting of beats, however precise, will not necessarily yield practical solutions. Though perfect theoretical accuracy is unobtainable and probably undesirable, Jorgensen's remark that "the equal-beating methods are more musical than the theoretically correct methods" seems to me entirely without warrant, even if one has any idea what he means here by "musical." When musicians tune, they will certainly try to equalize the quality, and thus the size, of intervals; if they succeed, the beat rates will be unequal.

What, too, are we to make of statements such as "the ratio of a just major third is 5 to 4, often written as 1.25" (when the latter figure does not explicitly indicate a ratio at all), or "tempered intervals sound unstable, and they pulsate"? The deliberate mistuning of unisons in some organ stops does not disturb the stability of that interval. In meantone, the beating of the tempered fifths softens the triads and seems to contribute to their particular beauty; no one would claim, however, that those fifths are "unstable." Jorgensen may intend to call attention to the unpleasantness of intervals mistuned to such a degree that their beat rates are very fast, in the neighborhood of 20–35 beats per second. And what of the statement that "no compromising [of just intervals] was done until the late fifteenth century, when a few just intervals were tempered very cautiously"? Or, "Pythagorean tuning was used from the beginning of keyboard instruments through the Renaissance"? Generalizations such as the latter two do little good unless the author can support them with some real evidence.

The question of so-called "wolf" intervals is another one in which Jorgensen hinders, rather than assists, the musician. On page 6, in referring to the diminished-fourth interval G sharp–C in meantone or just intonations, he claims that "this interval was called a wolf because it howled or beat so rapidly that it could not be used in musical performance." The use of the diminished fourth is in fact so common in keyboard music of the era in which meantone was favored that no examples need be cited. In his previous book Jorgensen did acknowledge this: "In the sixteenth, seventeenth, and eighteenth century composers often utilized the wolf sounds of meantone temperament for dramatic, tragic, comic, or other special effects. Therefore, when

performing compositions which obviously contain this spirit, the wolf interval should purposely not be avoided" (*Tuning the Historical Temperaments by Ear*, p. 117).

Generally the term "wolf" is and has been accepted as a description of the tuning discrepancy at the loose ends of the sequences of tuned intervals in a non-cyclic temperament; this is historically E flat–G sharp, whether taken in just, meantone, or Pythagorean disposition of the twelve keyboard notes. There is no sense in the indiscriminate condemnation of intervals such as augmented seconds and diminished fourths as "wolves" because they sound rough in a particular temperament; one rather should rejoice that they sound like the dissonances they are.

The temperaments and tunings Jorgensen has included will be of varying value for the musician. Unfortunately, he makes very few useful suggestions as to style, era, or repertoire appropriate to a particular tuning. The Agricola tuning (p. 13) will be useful only for those few pieces pointed out elsewhere[2] in which it is desirable to have pure major thirds on D, A, E, and B (the rest of the major thirds are Pythagorean). In the Grammateus temperament (p. 14), the most commonly used major thirds, those on C, G, and F, are Pythagorean (that is, half again as much too wide as major thirds in equal temperament), and it is difficult to see how their grating sound might have "[satisfied] the requirements of early composers such as John Bull," as Jorgensen suggests. Grammateus's temperament, a perfect theoretical construction in its symmetry and logic, is quite useless for any real music. (Incidentally, the first word in the fourth line of the description of this temperament, "meantones," should read "mean semitones.")

In reproducing Jorgensen's versions of the unequal or irregular temperaments (often called cyclic or circulating temperaments, though these two categories technically include equal temperament also),[3] I

2. Namely, the Faenza Codex repertory and pieces in the Buxheim organ book; see Mark Lindley, "Pythagorean Intonation," *The New Grove Dictionary of Music and Musicians*, vol. 15, pp. 486–87.

3. Jorgensen's attempt to justify "well-temperament" as a technical term by apparently relying on a phrase in the full title of Werckmeister's 1691 treatise, *Musicalische Temperatur*, is misinformed. The phrase quoted by Jorgensen, "wol temperirt

found them mostly very satisfactory, especially the one-sixth comma Thomas Young and the roughly one-fifth comma "Common Model" temperaments (pp. 27 and 29). Two errors should be noted on page 22: the Aron-Neidhardt temperament (also known as Kirnberger III) divides the comma into four, not five, parts, and the comma in question, referred to in footnote 14, is not the ditonic but the syntonic comma. As a practical suggestion, I recommend tuning the frequently used intervals *b flat–d'* and d'*–f' sharp*, which Jorgensen relies on again and again in his tuning schemes, in the octave below middle C (an octave lower than indicated), since the beats, being twice as slow, are much easier to hear there. In the Kirnberger temperament (p. 23), there is no reason for the inclusion of the hard-to-tune pure minor third, an interval Jorgensen requires to be tuned nowhere else in his book. An identical tuning result will be obtained much more easily by tuning a pure major third from *f* up to *a*, or, even easier, a pure fifth from *e'* down to *a*.

The most puzzling interpretation of a historical temperament in the book is the one called "Rameau-Rousseau-Hall" by the author (pp. 19–20), and, even though it has three footnotes, there is no explanation of how it was derived (it is also not to be found in Jorgensen's previous book). Its relationship to Rameau's modified meantone, one of a collection of temperaments commonly known as *tempérament ordinaire*, is clear. Regrettably, Jorgensen's temperament is virtually useless: the four excessively widened fifths from C down to A flat ruin the major thirds in the flat keys (Couperin's and Rameau's beloved B-flat major is spoiled by a major third a comma wide, besides the

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stimmen," means "to tune in a well-tempered way"; "stimmen" is a verb, not a noun, and "wol temperirt" is adverbial. Let's hear no more of Jorgensen's illegitimate term; plenty of legitimate ones exist, and there is no need to add further corruption, thinly disguised as technical jargon, to the English language. Interestingly, the German term for equal temperament, "gleichschwebende Temperatur," means "equal-beating temperament," not in the sense of numerically equal beats, but rather equal proportion. Jorgensen's misconstruction of "equal," as suggested above, seems to me the crux of his fallacy. An elegant, clear, thorough, and musical treatment of the sometimes exasperating subject under discussion here can be found in the book *Intervals, Scales, and Temperaments* by Ll. S. Lloyd and Hugh Boyle, now in a second edition (New York: St. Martin's Press, 1978).

wide fifth; E flat is much worse), and the excessive purity of the sharp keys is no compensation.

Much better are the versions given by Klop[4] as "Rameau" (though he gives no tuning instructions) and Lindley[5] as *tempérament ordinaire*. Murray Barbour has quite a different interpretation of Rameau's (intentionally?) ambivalent temperament instructions,[6] and his "Rameau temperament" nicely but subtly favors the flat keys. It is easy to tune: set the standard quarter-comma fifths, *g–d'*, *a–e'*, *c'–g'*, and *d'–a'*, comprised in the pure major third *c'–e'*, and, continuing as if one were tuning meantone, set *f*, *b flat*, and *b natural* as pure thirds from *a*, *d'*, and *g*, respectively. (Or, simply tune a string of quarter-comma fifths from B flat through B, seven in all, as nearly as possible equal in size.) Then tune three pure fifths: B–F sharp, F sharp–C sharp, and C sharp–G sharp. The remaining tone, D sharp/E flat should first be tuned pure to G sharp a fifth below, and then raised until the common-tone fifths G sharp–D sharp and E flat–B flat are each wider than pure by the same quite noticeable amount (ideally E flat–B flat will beat half again as fast as the G sharp–D sharp immediately below it).

In *The Tuning of My Harpsichord*, Dr. Herbert Anton Kellner offers us a worthwhile addition to the growing number of books on tuning and temperament: an English translation of his 1976 booklet, *Wie stimme ich selbst mein Cembalo?* The translation seems to be his own; though it reads like a translation, it is generally clear, even if the occasional teutonicism slips by (p. 15: "For the musical usage of this harmonic scale already the fifth is prohibitive"; p. 40: "Walther was 1704 a student of Werckmeister"), and a few sentences may not make sense in any language (p. 28: "The basic method above is applied in the mean-tone temperament infinitely often in practice"). A crucial

4. G. Klop, *Harpsichord Tuning* (Garderen: Werkplaats voor clavecimbelbouw, 1974), p. 17.

5. Mark Lindley, "Instructions for the Clavier Diversely Tempered," *Early Music* 5 (1977): 22–23.

6. J. Murray Barbour, *Tuning and Temperament: A Historical Survey* (1951; reprint ed., New York: Da Capo Press, 1972), p. 135. In his *Nouveau système de musique théorique* (Paris, 1726), Rameau clearly states that the narrowing of the fifths is to begin with B flat, an instruction followed only by Barbour.

sentence in the tuning instructions should be corrected, however; on page 41, the phrase following the comma in the third line from the bottom should read, "such that it beats at six times the rate of the well-tempered fifth B–f° sharp."

In this booklet, and in a series of related articles (listed by the author in a bibliographical section on pp. 52–54), Kellner contends that he has discovered "the well-tempered tuning of Johann Sebastian Bach." His methods of reconstruction are largely those of numerical manipulation, and this is no place to evaluate them—indeed, the author himself wisely excludes them from the book in question here. Since there is no direct evidence of Bach's preferences in tuning, any so-called "Bach temperament" must be conjectural. Kellner's temperament, a modification of the one-fifth-comma unequal variety, is quite a good one, though perhaps not as good for Bach as the one-sixth-comma unequal temperaments of Young/Vallotti, or of John Barnes (which was derived specifically for the music of Bach by a shrewd and musical analysis of Bach's use of certain intervals in the first book of the *Well-tempered Clavier*).[7] Kellner's tuning method, while ingenious, produces a C-major triad much too nearly pure, in both the fifth and the third, to be plausible for Bach; surprisingly, and inappropriately, it is purer than the C major of Werckmeister III. Compared to music by his predecessors, or even by a contemporary like Handel, much of Bach's music has the harmonic restlessness of that of much later composers, suggesting a temperament nearer equal —that is, with wider major thirds—than the common Kirnberger or Werckmeister models, or Kellner's "Bach temperament"—at least to this writer's ear.

The remaining temperaments presented by Kellner are familiar ones: quarter-comma meantone, Kirnberger III, Werckmeister III, and equal, all of which are available in a number of other sources. Kellner takes up meantone first, evidently on historical grounds, but in my experience it is too difficult a temperament to begin with, since the tempered fifths should all be the same size, as already noted—quite a demanding task for the novice tuner; in the unequal temperaments, a slight skewing of the tempered fifths will not seriously dam-

7. John Barnes, "Bach's Keyboard Temperament," *Early Music* 7 (1979): 236.

age the result. In addition, meantone cannot be set until the tuner has mastered the pure major third.

Kellner's meantone presentation includes a nice feature, a reproduction of Praetorius's steps for tuning meantone temperament from the second volume of the *Syntagma musicum* (1619). An interesting curiosity of this is the antepenultimate step, which indicates that a quarter-comma fifth is to be tuned between "*b flat* and *d sharp*," followed by a check for a pure major third between "*d sharp* and *g*." These are the note names Praetorius himself uses, and it is interesting to speculate on their significance, if any.[8]

There is an interesting feature in Kellner's presentation of the Werckmeister III temperament too: he tunes eight pure fifths in a cycle from C around the flat side to E (really F flat). The resulting C–F flat is equal to the interval of a pure major third (C–E) minus a schisma (2 cents); he then divides C–F flat in the usual way into four equally small fifths, which he calls "Werckmeister fifths" since they are a half schisma smaller than the quarter-comma fifths (which he calls "meantone fifths") of meantone or Kirnberger III. Kellner unfortunately does not explain this terminology, nor the fact that by a neat trick he has divided the ditonic comma here rather than the syntonic. (In this respect Kellner's tuning scheme for Werckmeister III differs from the other modern versions familiar to the reviewer.) Kellner also is not clear about whether this tuning scheme is his own, or comes from Werckmeister's own tuning instructions.

In so well organized, and purportedly systematic, a book as this one, defects do tend to stand out, and I list here the major ones I encountered: the two commas, syntonic (a measure of discrepancy

8. Evidence in the music has convinced me that E flat was frequently tolerated and perhaps even enjoyed as a substitute for the leading-tone D sharp in meantone (even though the E flat seems at first much too sharp to our ears), especially in the Italian and English keyboard repertoire. Examples of the cadential use of D sharp, where it is momentarily touched on (and could be disguised with an ornament), are not uncommon in the music of Byrd, Tomkins, and Frescobaldi, for example. A case of a possibly deliberate coloristic use of E flat in lieu of D sharp can be found in the familiar "Under the Linden Green" variations of Sweelinck, meas. 65 (Jan Pieterszoon Sweelinck, *Ausgewählte Werke für Orgel und Klavier*, ed. Diethard Hellmann [New York: C. F. Peters Corporation, 1957], 1: 74). This may be a question of personal taste; I find any other tuning for the written D sharp in this passage much less charming.

between cycles of pure fifths and pure thirds), and ditonic (a corresponding measure of discrepancy in cycles of pure fifths and pure octaves), are never treated adequately, nor is their common difference, the schisma; and yet all temperament theory, including Kellner's own rather protracted explanations, depends on a clear understanding of what they represent. Nor is the difference between the diatonic and chromatic semitone made clear, crucial as that difference is, for musical reasons, in meantone—this despite the pages of figures and tables. In addition to a clear identification of the two semitones, it would be helpful to add them to the table of important intervals on page 33: meantone chromatic semitone, 76 cents; meantone diatonic semitone, 117 cents.[9] The table might also include the Pythagorean semitone, or limma (perfect fourth minus a Pythagorean major third), ratio 256/243 (90 cents). Finally, an obscure reference might be clarified: the leftover fifth, F sharp–D flat, in Kirnberger III, created by tuning pure fifths outwards in both directions from the two tones of the pure third C–E, down to D flat and up to F sharp, respectively, is one schisma smaller than pure. Without explanation or definition, Kellner calls this (p. 34) an "equally tempered fifth." What he means, but does not say, is that it is virtually identical in size with a fifth in *twelve-tone* equal temperament. Is it pure coincidence that twelve schismas make up almost precisely a ditonic comma, the excess of twelve pure fifths over seven octaves?

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9. In case anyone cares about the ratios of these intervals, they are $25/(16\sqrt[4]{5})$ and $8/(5\sqrt[4]{5})$, respectively. Kellner's ratios for the mean tone and meantone minor third are printed incorrectly: they should read $\sqrt{5}/2$ and $4\sqrt[4]{5^3}5$, in that order. Music theorists with pocket calculators might like to know that if they have a frequency ratio r of an interval (r>1), they can compute its value in cents—very handy for comparing interval sizes—by means of the formula: $I_{cents} = 1731.234 \ln r$. (If the ratio is read in string lengths, as on a monochord, the string-length ratio should be inverted to obtain the frequency ratio.)