FOLKMUSIC AND COMPUTERS

by

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Nowadays one hears more and more about the use of the computer as an aid in the study of music, which is hardly surprising when one realises that all music is based on laws of logic and that computers are built to follow such laws. For example, I recently programmed an IBM 1440 computer to print a graph comparing African and European musical scales, utilising the system Dr. Tracey designed many years ago. This system is based on the fact that Africans sing notes which are not recognized in the accepted scale of twelve semitones and therefore cannot be written down accurately on conventional music paper, but can be illustrated on a graph using factors obtained from a mathematical table devised by Dr. Tracey. These factors are obtained from the table using the pitch of a note expressed in vibrations per second; this number having been established by Dr. Tracey, previously using a special set of tuning forks and more recently with the aid of a stroboscope.

The table of factors is fed into the "memory" of the computer as an unbroken series of numbers through which the computer scans until the appropriate factor is found. The first two figures of the vps number are compared to the row number in the table (corresponding to the outside columns, numbered 8 to 80, in Dr. Tracey's "Table of Cents"), the process continuing until an equal comparison is made. The correct factor is then found in the table by adding 4 for every value, including zero, of the final figure of the vps number to the location in the computer of the row number, e.g. if row 14 were at position X, the factor for 142 vps (0888) would be found at $[X + (4 + 4 + 4)] = X + 12$, because from 0-2 inclusive is three values. The factor number will be the figure at position $X + 12$ and the three figures preceding it.

To produce the graph, the smallest vps number is taken as the tonic (in graph I, fig. 1 this is 120 vps) and its position marked off as being equal to C. (N.B.—the actual note need not be C, but for the purpose of the graph it is taken as such). The factor of the tonic (0596) is subtracted from that of the following note (142 vps, 0888) and the result is divided by 100, this figure then representing the interval in semitones between the two notes, e.g. 0888 — 0596 = 292 = 2.92 semitones. This is corrected to one decimal place and the note is marked off on the graph by moving an asterisk to position $[X + 101]$ in the computer, where X is the result of the above calculation and 101 is the first position in the print area. In this instance the asterisk will fall at position 29 + 101 = 130, or 1/10th of a semitone flat of D♯. The process is repeated for each subsequent note until the octave is reached, giving a result of nought on subtraction since the vps number of the octave is exactly twice that of the tonic, and both have the same factor.

If the final note is flat of the octave, the vps number will be less than twice that of the tonic, the factors will be unequal, and the note will fall short of the last position on the graph, as in graph III, fig. 1. Conversely, if the final note is sharp of the octave the vps number will be greater than twice that of the tonic, the factors will again be unequal, but the note will fall beyond the octave position. A disadvantage here being that the note will not appear on the graph if it is more than two semitones sharp because of the limited area within which the computer was designed to print (from positions 101 to 244). The note will appear inside the computer, but outside the printing area, and will probably disrupt the programme of instructions in the computer causing it to halt in an error condition.

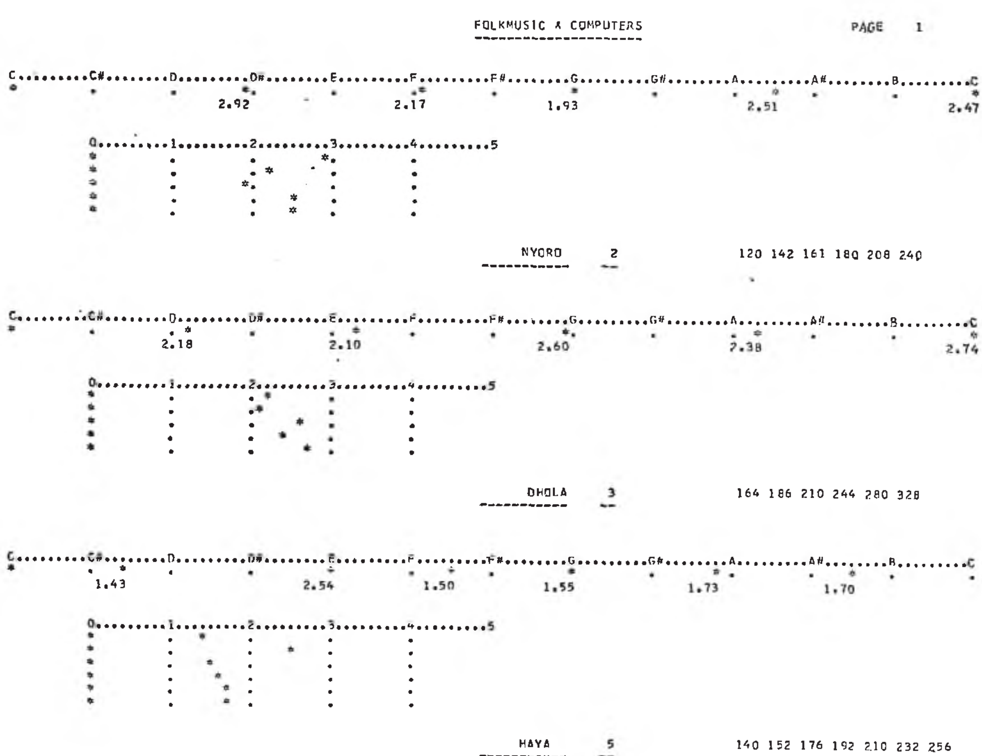
If a factor is smaller than the one being subtracted from it, 1200 (one octave, 12.00 semitones) is added to the smaller number and the subtraction is continued as before, e.g. to subtract 120 vps (0596) from 180 vps (0098): 0098 — 0596 = (0098 + 1200) — 596 = 1298 — 596 = 7.02 semitones.

Finally, below each note the interval between it and the previous note is printed, so that the interval between any two notes can be calculated by finding the difference between their respective intervals from the tonic. The interval between a note and the tonic is found by adding together all the intervals of the intermediate notes.

The second graph is produced by taking each note as the tonic of the following note, the calculations involved being much the same as those employed in the production of the first graph, except that the position of the asterisk is now $[X + 111]$. The graph shows the relationship of the notes to each other (in graph I, Nyoro, this relationship seems to be 2, 2½, 3 semitones) the significance being that the notes used in the music of individual African tribes bear a definite relationship to each other and are not just chosen at random.

Below each graph some means of identification, tape or record number, track number, etc., is then printed, in this case the name of the tribe, and the vps numbers in the sequence in which they are used by the computer. All this information and the vps numbers will first have to be punched into cards.

The advantages of using a computer to calculate and produce graphs such as these are threefold. First the computer is not prone to human error, so the correct result is guaranteed if the initial data (vps numbers) is correct; secondly the computer can work much faster than a human being, graphs I, II and III being produced in about ten seconds; and thirdly, the graph is simplified by equating the axis to the scale of C instead of allocating numbers to the semitones, i.e., instead of calling the semitones 1,



2, 3, etc., I have called them C, C♯, D, etc., meaning that the concept of singing notes which "don't exist" can be better understood by the layman.

The only disadvantage is the actual degree of accuracy to which the computer can print because of the limited printing area, Dr. Tracey's method being correct to 1/100th of a semitone whereas the computer can only print to 1/10th, but this is close enough for all practical purposes.