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Etude

the music magazine

JULY 1952
40 CENTS
\$3.50 A YEAR

IN CONGRESS, JULY 4, 1776.

The unanimous Declaration of the thirteen united States of America.



In march time



In this Issue . . .

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International Dictionary," a carillon is "An instrument comprising at least two octaves of fixed cup-shaped bells arranged in chromatic series and so tuned as to produce, when many such bells are sounded together, concordant harmony. It is normally played from a keyboard which controls expression through variation of touch."

Another definition of "Carillon," also listed in "Webster's," reads: "An instrument capable of creating electrically amplified bell-tones by striking small variously shaped metallic bodies arranged in chromatic series of two octaves or more and so tuned as to produce, when sounded together chordally, concordant harmony which is comparable in timbre and volume to that of a carillon of cast bells. (See Carillon I in Dictionary.) It is normally played from an electrically or mechanically



Manual clavier for cast bell Carillon

operated standard keyboard, and dynamic expression is achieved by electrical or mechanical means. Often loosely called electronic carillon."

It is readily understood that the carillon is an instrument of a good many bells and one upon which not only melody but also varied harmony may be played. In short, it is a musical instrument, capable of expressing music as we know it, feel it, and write it, complete with all its scales, arpeggios, chords, and full harmony.

This is indeed a far cry from the old

notion of bell-chimes, in this country at least, where only the melody of a song or hymn could be expressed, in a dirge-like tempo, one note at a time. The bells of such instruments were—and still are, of course—too false to allow any other type of music. Since the time when these bell-chimes were installed, our musical sense concerning bells has developed. Musicians and the man in the street alike often remark now-a-days that the old chimes sound out of tune. They are quite right. But some musicians, those who know only this older (for us) type of bell music, are wont to classify bell music in general as "something old, archaic, perhaps charming at times, but still quite some distance from being exactly musical." They are wrong. Nothing could be farther from the truth!

Returning to the definition, the bells of a carillon are so tuned as to produce harmony. Therefore, they are not just any bells; they are tuned bells. And what is a tuned bell?

In considering this question, we must disregard the traditional chime of bells. Certainly many times an effort has been made to see that the bells of our chimes are more or less in tune with each other, but in such a series one bell often differs enormously from another in tone quality and thus may belong to a tone family entirely different from that of its neighbors. So every bell sounds just a bit different. This is due, of course, to the differences in the partial tones of each individual bell—differences in pitch, and also in the intensities of the all-important partials. These chime bells are not in tune with themselves, since the series of notes of which each bell is composed is discordant to begin with. To understand just how this can all be, and to appreciate the perfection of a tuned bell, we must first review the basic rules of tone itself.

We define a musical note as one made up of a harmonic series of overtones. The tones of a string and pipe are composed of natural overtones, or harmonics, since by nature they divide themselves, when producing tones, into two parts, three parts, four, five, six, seven, eight, etc. parts, and each part is in perfect ratio to the fundamental; each part vibrates separately and lends its own harmonic tone to the note and thus helps to establish the timbre of that note.

But it is generally not known that a musical tone does not have to be made up of a harmonic, or natural, series of overtones. In fact, a good many of our instruments owe their particular appeal to notes which are made up of a series of overtones which do not conform to the natural

series. It is imperative, however, that whatever series of overtones these unnatural instruments do possess, they must either be very few in number, and these must be harmonious—or, if the series be complicated, it must approach as closely as possible the series of natural harmonics.

And to the class of instruments possessing an extended and complicated series of overtones, or partials, the bell belongs.

As with any vibrating object, especially one which generates a musical tone, the sound of the bell is made up of a whole series of tones in harmonious relationship. It is these overtones which, in their particular position and intensity, give to the bell its timbre. We shall have all the more respect for the perfectly tuned bell—and for those founders who made them—once we understand that nature did not ordain the series of overtones in the bell, as she did do in the case of the string and the pipe. Man himself first had to discover what form of bell embraced the most musical series of partials, and then he had to learn how to control these partials.

Pipes and strings are exceedingly simple in form. When they are set into vibration, they automatically divide themselves into their several harmonic partials, each a ratio of the fundamental. When a piano or organ tuner tunes his instruments, he listens only to the basic note, the fundamental, and tunes that. Little does he worry whether the octaves, the thirds, the fifths, preserve their places in the series of overtones. Nature herself takes care of all that.

Tuning a bell does not come so easily to the bell founder. Each one of the tones in a bell can vary in its desired position. Indeed, they have no position until man masters them and puts them there, carefully turning off the metal on the inside of the bell and stopping every few minutes to check his tones. If he should go too far, if he should tune even one partial too low, the bell is lost and must be recast.

So, to answer a question asked previously, a tuned bell is one which has had all its partials put into pleasing relationship to the fundamental, an infinitely meticulous task. A perfectly tuned bell is often described as a "perfect" bell, and it is a credit to any founder who knows how to achieve one.

What are the partials that the founder concerns himself with in making a perfect bell? How do they compare to the series of natural overtones?

Looking at nature's overtones as expressed in strings, pipes, reeds,—the so-called "natural series" of harmonics—and the series of overtones in the bell, we find that there are some (Continued on Page 62)



Earl B. Collins (left) organist First Presbyterian Church, East Orange, N. J., and (right) the author of this article with Dr. Paul M. Oberg, Dir. of Music, Univ. of Minn., at the console of the Schulmerich 61-note "Carillonic Bells"

And What About the Electronic Carillon?

The Bell-master of
Princeton University
makes a comparison
of the two types
of carillons—
Cast Bell and Electronic—
with highly interesting and
informative results

by Arthur L. Bigelow



Schulmerich 61-note "Carillonic Bells," Flemish type console

IN THIS DAY and age we often hear expressed: "It is the result that counts, not the medium by which it is achieved." In our modern world we have discovered that a same result may be obtained by different means, and that one particular way may be more appropriate under certain circumstances than another—though both ways are equally commendable.

The carillon is a good example of this situation. What about it? Is it true that electronic bells and cast bells can both achieve the same effect? Why would one

be more desirable in a particular instance than the other?

Let us compare the two and judge them fairly, the one in the light of the other. Let us concede to each instrument all its merits, all the points in its favor, weighing them both together. Surely such a comparison, carried out on a disinterested and scientific basis, can only result in a better understanding of the two instruments and be of value to anyone interested in bell music. Anyone who begins a discussion of the carillon—or of anything, for

that matter—with "I prefer—" without an intimate knowledge of all points comparable and all issues involved, not only shows his utter ignorance, but also classifies himself as prejudiced and unfit to judge, for there are usually many things in favor of each side of a question. How does it stand with the carillon?

Let us start our discussion with the accepted definitions of the two instruments involved. According to the definition drawn up at the Carillon Congress held at Princeton in 1946 and accepted by "Webster's

very distinct differences. (See diagrams below.) Comparing the two series in their ratios to the fundamental, we have:

C-C	-C-C-E-G-B \flat -C-etc.
1 2	3 4 5 6 7 8
C-C-	E \flat -G-C-E-G C-etc.
1 2	2 4 3 4 5 6 8

It will be recalled that the fundamental, or strongest tone, of the *natural series* is its first tone, designated by "1" below. This is not so in a bell, where its strongest tone is in the second position of the series, and is called the Strike Tone. In unison with the strike tone is the Prime Tone. It is absolutely imperative that the Prime sound as one note with the Strike. One of the greatest deficiencies in the majority of our chime bells is that the Strike and

only in some registers of the instrument and, in fact, can be avoided almost entirely in writing and arranging for the carillon, so that it is in no way hindrance.

We would not want to rob the bell of its minor-third, for it is this tone which gives the bell its peculiar characteristic, its plaintiveness, and its appeal. Indeed, it gives it its whole personality.

Centuries ago it was discovered that the bell must have the series of overtones described above, and since then carillon bells have been produced and tuned to this series. Then how does this new type of carillon—the electronic type—compare with the older form employing cast bells?

In no manner whatsoever may the tones of an electronic carillon differ

which makes a bell sound like a bell and not like a xylophone or a celestaphone, or a tubular chime.

How then may the two instruments be compared? Isn't such a comparison difficult, and would it not mean placing the two instruments side by side, performing first on one and then on the other? Such is precisely the only way a valid judgment of them can be reached, by testing the two at the same time, in the same place, and under the same conditions.

Accordingly, an electronic carillon produced by Schulmerich Electronics, Inc. of Sellersville, Pa., comprising a full five octaves, extending two octaves below middle C and three octaves above, played from a standard piano-type keyboard, was

installed in a tower with a large carillon of cast bells. The cast bell carillon was one of over four octaves in extent and having a Bourdon of many tons—truly an instrument embodying all that a carillon should be.

And then the tests began. They were based on two things: first, the comparison

of the timbre of the individual bells, from the lowest to the highest, and their tuning; and second, the ability of the electronic carillon to produce, chord for chord, the same harmony of which the cast bell instrument was capable and the carillonistic effects it could achieve.

Using the most modern and perfected means for measuring pitch and tonal intensity, it was found that the bells of the electronic carillon were, in general, more accurately tuned than the cast bells. This does not mean that the latter were deficient. The nature of the partials of cast bells are such that their minor-thirds, and for instance, fifths may deviate somewhat from the norm without detracting from the purity of the bell. The same partials in the electronic bells were right on the line.

The Strike Tone and Prime blended together perfectly, as they did in the cast bells. The Hum Tone was present in all its resonance, a true octave below the Strike; the Octave sang out, high and clear, a perfect octave above the Strike. As in the case of the bronze bell, these four tones—Strike, Prime, Hum, and Octave—united to form a note of very definite pitch. Any bell not possess-

ing such to begin with is of lesser quality from the first.

The Minor-Third, in the electronic bells, was somewhat less in intensity than the same partial in cast bells. This means that the major-minor clash—as in the chord C-E—is measurably reduced.

The Fifth was almost imperceptible, if present at all. As in cast bells, this is by far the weakest partial.

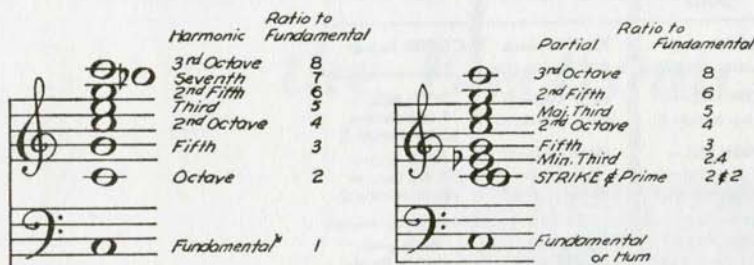
The upper thirds (major) and fifths in the octave above the Strike-Tone are not usually tuned in cast bells, being of relatively low intensity and unable to disturb the purity of the bell or destroy the harmony of a chord. In the electronic bells, however, they proved to be more important, adding a certain clarity and singing quality to the note, and were therefore tuned to perfection.

The double octave of the strike was found to be, as in the case of cast bells, a bit sharp. This gives, to both types alike, the "mordant" or "bite" which adds punch to the note.

The timbre of the two carillons was directly comparable because it was formed by the same series of partials and these partials were identical in pitch and had practically the same strength. So closely were the two instruments matched that it would have been impossible to tell which was which, if it had not been known which type of bell was being struck.

There is another element which enters into the picture at this point. As the carillon is an instrument of percussion, the sound of the actual striking of the vibrating body by a hard body is a part of the overall picture. To many, the sound of metal upon metal, in the case of bells, belongs to the note; to others, especially when the sound of the impact is somewhat harsh, it proves distracting. In this respect, the electronic carillon was "smoother" than the other, there being less of the noise of percussion. Which is more desirable—bell tones with an introduction of a strong metallic click or bell tones possessing less of the click? It is of course a question of personal preference.

One of the most noticeable differences between the two instruments was in the treble register. Here the electronic bells gave an excellent account of themselves. Their tone did not tend to diminish so quickly as the tone of the cast bell trebles. The electronic bells remained full and clear to the last bell. Not just "pinpoints of light," as in the case of most cast bells in the treble, they continued to sing almost as long as the bells of the middle register. Therefore, if it was desired to keep the bells singing throughout several



Natural Series of
HARMONICS

Series of PARTIALS
in a Bell

Prime most always have a difference of one-half to one whole tone between them, thus rendering the bell false at the very outset!

And then the Third. No imagination is needed to remark the existence of a note so close to the fundamental that it forms a minor-third interval with it. Such is certainly far removed from anything Nature ever dreamed. At once, almost any musician would be inclined to pounce upon it and declare it anti-musical, that the minor-third "should be major," or eliminated altogether, and that, as far as he can see, little harmony is realizable. Suffice it to say that he is wrong. The third could not be eliminated, nor would it be desirable to eliminate it. The third could be none other than minor, for all kinds of harmony are possible with the minor-third bell. Very little would be possible if the third were a major—given its position and its strength.*

It is true that there can be some "clash" when a major third chord is played on a carillon, due to the minor-third of the lower bell of the chord. But this clash is apparent

from those of the traditional instrument, if it is worthy of the name carillon. Any other series of tones in the makeup of its notes would immediately give the instrument another timbre, villify its purity or at least filch from it its singular bell quality. We cannot tamper with the tonal picture of the bell. Tone, of course, is the most important aspect, but, further than this, all that may be said of a cast bell carillon must hold true in the electronics. The same musical effects achieved with cast bells must be achieved with the electronic. Anything less would put the latter into another category at once.

How is it possible for an electronic instrument to qualify as a bell carillon, even though its notes do possess the same series of overtones as a cast bell? In considering the electronic type of carillon, we must not take "electronic" to mean a collection of radio tubes for the production of the bell tones. The truth is, that a proper electronic carillon is not very far removed from the cast bell instrument. Both create their tones by striking with a steel clapper upon bell metal. These blows cause the metal to vibrate and release the complicated series of overtones

*For a more detailed discussion of the minor-third, see "Carillon," by the same author, Princeton Univ. Press, 1948.

beats of a measure, it was not necessary to have continual recourse to the "tremulando" or "shake" as is customary—and necessary—with cast bells. The tremulando is the continued and rapid striking of the individual notes of a chord, altogether and without any rhythmical pattern. It is used to give the impression of a chord which endures as long as the time indicated for it in the written music. As higher bells ordinarily die out soon after being struck, the tremulando is of great service. But it is often used too much and detracts from the listening enjoyment when not judiciously employed.

From the above it is evident that a cast bell carillon, if composed entirely of small treble bells such as these, is not capable of rendering the fullness of tone that we have a musical right to expect. People often remark to a bell-master, "Play the bass bells; I like the bass bells best." Such would never be asked of a pianist or an organist whose instruments are completely balanced, tonally, throughout their ranges. If the treble register of a cast bell carillon

were tonally balanced equal to the rest of the instrument, there would be no occasion for such a remark.

In continuing the test, with a bell-master at the clavier of the cast bell carillon and an experienced musician at the keyboard of the electronic, the same chords and arpeggios were played, first on one instrument and then on the other. *No noticeable difference was heard.* Entire selections were executed, note for note the same, on the two instruments. The effect remained the same.

Not content with scientific comparison and the opinion of those technicians making it, it was decided to determine the effect of the two carillons on a certain public. On three different occasions recitals were held, using both instruments, before audiences having an intimate knowledge of bells. Each person in the audiences—sometimes numbering over a dozen—was given a copy of the program and asked to note, to the best of his ability, the instrument he believed each selection was played upon. In spite of their familiarity with bells, none of the listeners

had marked his program correctly!

There is a place for everything in this world. Where towers are high and sturdy, where their belfries are adequate and sufficient funds are available, then cast bells may be considered. This will necessitate a bell-master trained through long years of experience with a clavier quite unlike that of the organ or piano he is used to. But, if he should apply himself and learn his instrument, he will be able to create a mood with his bells, and give his listeners that very special music that only a carillon is capable of. But the situation is not always thus.

Towers in the New World are not always—indeed very rarely—high enough or strong enough, or appropriate to housing tons and tons of bronze. Funds may also be lacking. Still, people love bells and they are going to have them, one kind or another. Many times they have no choice but to install an electronic instrument. When it is chosen wisely, built to become a part of their tower, and played by a musician who has studied the carillon and all its pos-

sibilities, they will be able to enjoy a music which otherwise would be denied them. . . .

But they must choose wisely. Just any ringing tone does not make a bell—cast or electronic—nor does a series of such tones automatically make a carillon. Only a carillon of the purest tones can render that highest form of bell-music: harmony on bells. The true test of any carillon is found in the harmony it can create. A carillon composed of bells whose tones are matched and perfectly tuned, is a euphonic, not a cacophonic, instrument.

Given a tower capable of supporting cast bells and the funds to pay for them, a discerning musician is asked to choose a suitable carillon for the tower, and the question arises: "Shall we install a carillon of cast bells or electronic bells?" After hearing and comparing both instruments, his answer will depend entirely on his personal taste and his personal preference of one instrument over another—if he can tell the difference!

THE END

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