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History of Bells and the Evolution of the Carillon

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THE HISTORY OF BELLS AND THE EVOLUTION OF THE CARILLON

by

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This thesis submitted by Paul E. Lundquist in partial fulfillment of the requirements for the Degree of Master of Arts in the University of North Dakota is hereby approved by the Committee under whom the work has been done.

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PREFACE

Many lengthy treatises have been produced over the last six or seven centuries having to do with the art of bell-making and of bell-ringing. Most of these books--that is, the ones which are in existence at the present time--are now museum pieces reposing in foreign archives or libraries. With two or three exceptions, no books have been written on the subject since the early part of the nineteen thirties.

Most of the works studied are of considerable length, somewhat verbose, and brimming over with extraneous detail. I decided that the primary objective of this work would be to present a concise history of the bell's development, comment briefly on the many aspects of bell-founding, tuning, hanging, etc., bring to light a few facts concerning the techniques of the art (or science, if you prefer) of English change-ringing, provide some basic information on the traditional cast-bell carillon, and conclude with remarks on the modern electronic version of this instrument.

I should like also to acknowledge the contributions of many persons who assisted in the compilation and final writing of this material. Mrs. Helen Wills and the Chester Fritz Library staff were most cooperative in obtaining several of the older publications through inter-library loan. Immediate responses were received from M. Gaston Van den Bergh, the Assistant Carillonneur of the City of

Mechelen, Belgium, from the Embassy of The Union of Soviet Socialist Republics, and from the Beiaardschool (Carillon School) at Mechelen, Belgium. Finally, I would like to express my sincere thanks to the members of my graduate committee, Dr. William R. Boehle, Dr. Foster Y. St. Clair, and Professor Philip B. Cory, under whose direction the thesis was written, and who have provided much guidance and assistance in the course of its preparation.

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CHAPTER I

A SHORT HISTORY OF BELLS

From the Time of Moses to the Sixteenth Century

During the time of preparatory reading and the collecting of material relative to the subject of bells, the record of their history and their contribution to man's daily life has left quite an impression on me. Bells, at least in our present day, are taken for granted and we frequently fail to recognize the fact that they are serving our needs in many capacities. At our own University, as an excellent example, it would be interesting to know what percentage of students and faculty actually hear the bells striking the hours and quarter hours--not to mention the short programs that are heard at certain parts of the day via the automatic player. Away from the campus there are other tower instruments, as well as installations atop certain business places, that play quite frequently during the day. How many people are really aware that this music exists?

Naturally, many of the bell sounds we hear today--the school signal bells, door bells, train bells, alarm bells of various kinds--have been changed or refined to a point where it becomes quite a challenge to relate them to their ancestors. As a general rule, bell-ringing has lost the personal touch of the human "beiaardeer."[1]

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[1] Bell-ringer or Bell-master.

The practice has been taken over, for the most part, by electronic devices of various kinds. Dr. Percival Price, long-time carillonneur of the University of Michigan, wrote these words as long ago as 1933:

> As time passes the carillon like other instruments will be changed from its present form, and with the rapid succession of inventions which have thrown all the musical world into a state approaching revolution, today it is a practical impossibility to foretell with any accuracy what the "singing tower" of the more distant future will be like. It may be made into an instrument where both clapper and key will be done away with and an electrical console under the more exact control of the performer will cause the bells to sing out without ever being struck.[2]

Dr. Price's prophecy has now become a reality. Carillons of forty to sixty bells were, at one time, considered giants. Now, however, we have instruments, electronically controlled and operated, consisting of twenty-five, three hundred, and even fifteen hundred so-called bells.

Before approaching the subject of the carillon on too large a scale we should try to absorb something of the history of the one component part of the instrument, without which there could be no carillon.

First of all, what exactly is a bell? There are almost exactly as many definitions as there are dictionaries or encyclopedias. One of the leading musical scholarly works defines the instrument in the following way:

> BELL: The word is derived from the Saxon "bellan" = to bellow, to make a noise.[3]

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[2] Percival Price, The Carillon (Ann Arbor: University of Michigan Press, 1933), p. 28.

[3] "Bells," Grove's Dictionary of Music and Musicians, Third ed., Vol. I.

This work also indicates that one of its sources was Dr. Johnson's Dictionary, dated 1755, which described a bell as "a vessel or a hollow body of metal formed to make a noise by the action of a clapper. A certain Dr. Busby, writing in 1786, defines a bell as "a well-known pulsative metallic machine which is ranked amongst musical instruments."[4] From these sources, as well as others that have not been mentioned, we might concoct our own definition, as follows:

> BELL: A hollow body of metal made of an alloy of copper and tin, sounded by striking with either an inside clapper or an outside hammer, and formed in such a way as to give out a musical sound when it is struck.

Kamiel Lefevere, the world-reknowned carillonneur, provides food for thought when he suggests that the word "bell" may conceivably be derived from the Latin pelvis, a basin, or more accurately a foot-pan, being composed of pes = foot, and lavo = to wash.[5]

Whatever the definition, it must be admitted that bells are instruments of great antiquity, and that the exact dates of their origin or invention are indefinite and nearly impossible to determine. J. R. Nichols, one of our more recent authorities writing in 1928, has the following comment:

> An acceptable theory is that they have attained their present form and perfection of tone by experimental work carried out through the ages.[6]

How far back then are we able to trace the bell's history?

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[4] Ibid.

[5] Kamiel Lefevere, A Short History of Bells (Alfred, New York: Alfred University Press Historical Series, 1940), p. 4.

[6] J. R. Nichols, Bells Thro' the Ages: The Founder's Craft and the Ringer's Art (London: Chapman and Hall, Ltd., 1928), p. 2.

In the writings of Moses, some of the oldest literature still in existence, "bells of gold" are mentioned as being suspended from the robe in which the high priests performed their duties within the sanctuary. To the congregation the sounds of their ringing signalled the priest's arrival from the "Holy of Holies."[7]

Wooden bells of various shapes have been made by primitive tribes. One of the most common types was made of two pieces of wood, hollowed out and fastened together with a clapper (or sometimes several clappers) put in between them. When hard wood was used these bells were extremely live, and wonderful effects could be obtained from them. In some parts of Asia and Africa natives still fasten bells of this kind on the neck, legs, or even the ears of elephants in order to keep track of their movements.

Dr. Satis N. Coleman, an early enthusiast of the history of the bell, adds the following information to our already growing stock of facts:

> Probably the first ringing sound produced by a primitive man (as we think of the word "ring") was made when he suspended a piece of sonorous stone by a thong or a cord of some kind, and struck it with a stick or another stone. These stone gongs doubtless led primitive people to experiment with the sound of various types of metals. The first experiences with metal must have revealed to the savage its superior resonance over wood and stone, and stimulated him to shape it into forms that would ring. Little bells were made of metal in the exact shape of nuts, with bits of metal or pebbles on the inside to make a jingling sound. Thus, when gong material and rattle design were combined, the first metal bells came into existence.
>
> When this point had been reached in the working of metal, the field was then open to the imagination of the blacksmith who, of course, made all the bells among primitive peoples. A great many sizes and shapes resulted, all the way from small concave

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[7]Exodus 28:33-4, and Exodus 39:25.

pieces of iron up to our own idea of what a bell should be like.[8]

Webster's Dictionary implies that a bell must be made of metal. This definition, however, does not take into consideration the wooden, horn, or clay bells of the primitives, or the wooden temple bells of the Chinese (called "chung"). China, incidentally, used this same word to describe her metal bells long before the European bells had even been thought of. Therefore, if the usage of a word over a period of many thousand years carries any weight, we have to give a somewhat broader scope to the meaning of "bell."

There are several instruments that seem to be so closely bound to the bell family that they ought to be defined here as to their typical characteristics.

CASTANETS	:	Two pieces of wood or bone which make a clicking sound when knocked together.
CYMBALS	:	Two plates of metal which make a resonant sound when clashed together.
DRUM	:	A hollow substance with one or two coverings of skin or cloth (or membrane) which vibrates when struck.
GONG	:	A slab or plate of a substance which gives out a resonant tone when struck.
JINGLE	:	Bits of hard substances so fastened that they strike against each other or against another hard substance when shaken. The Egyptian "sistrum" is an excellent example of this type.
RATTLE	:	A closed cavity of some hard material containing one or more loose bits of hard substance which make a noise by striking the inside of the cavity when shaken.
TAMBOURINE	:	A shallow circle of wood covered with a membrane on one side, and with bits of metal fastened to the rim. This instrument is sometimes classed with drums.

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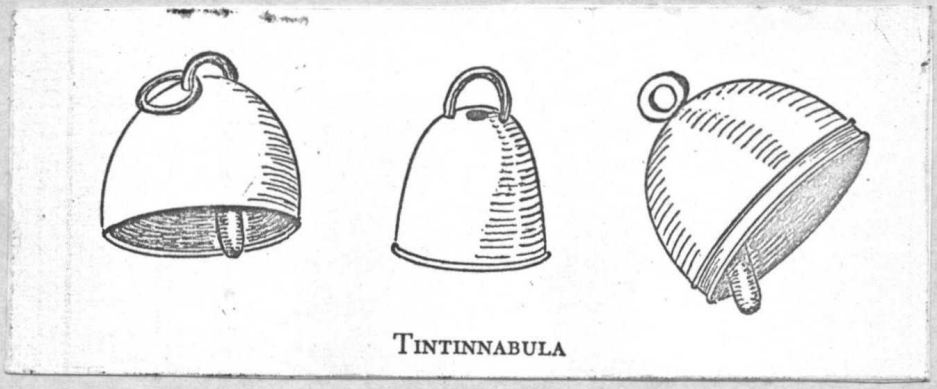
[8] Satis N. Coleman, Bells: Their History, Legends, Making and Uses (Chicago: Rand McNally & Co., 1928), pp. 17-18.

TRIANGLE : A bar of metal bent into triangular shape, open slightly at one angle.

If we consider that the castanet is the modern version of the ancient "click-stone," which Dr. Coleman says could more properly be called a gong, then the gong is older than the metal bell and may well be called its direct ancestor. She goes on to say, "When the gong took on a hollow cup-like form it became a bell. When the rattle began to use an open cavity, it, too, became a bell. And finally, when the bell had a skin or membrane fastened over its opening it became a drum."[9]

The most ancient civilizations of which we have any record seem to have made use of metal bells. We have already mentioned China, where bells are known to have been in use for over forty-six centuries. J. P. Briscoe, in Curiosities of the Belfry, points out that Sir Austen Henry Layard, the archaeologist responsible for the discovery of the ancient city of Nineveh, mentions small handbells



TINTINNABULA

being found in the Palace of Nimroud, and also the finding of some types of sculpture at Kuyunjik which indicated that bells had been

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[9]Ibid.

attached to the harness-rigging of Assyrian horses.[10] The Romans used bells for summoning people to the public baths (as did the ancient Greeks), and the night-watchmen of Rome carried them on their rounds. Pliny is quoted as saying that "the tomb of an ancient Tuscan king was hung round with bells."[11] Sheep and cattle bells of a "crotal" style that were used by early Italians are still preserved in the Museum of Naples.

Throughout history specific names have been given to certain types of bells. Dr. Lefevere has presented the following list in his pamphlet, A Short History of Bells. Since these classifications are of definite historical significance the excerpt will be quoted in its entirety:

> (1) TINTINNABULUM, a little bell. This word is probably derived from "tin-tin," a tinkling sound of a tiny bell; or else from the Latin "tinnitis," which means "ringing."
>
> (2) PETASUS, a large sized bell, so called for its resemblance in shape to a broad-brimmed hat. The word itself is significant of this meaning. This seems to have been the signal giving instrument the Romans used at their public baths. It was suspended and struck with a hammer, like a gong.
>
> (3) DODONA LEBETES, originally applied to a copper cauldron-like creation. It is mentioned in some accounts of the Spartan funeral celebrations.
>
> (4) CODON, a Greek term for what we would call a hand-bell. The meaning of the word signifies the wide orifice of a trumpet, hence the open-mouth form of the bell is suggested. These bells were used by sentinels in Grecian encampments to keep the soldiers and guards attentive at their posts.

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[10] J. P. Briscoe, Curiosities of the Belfry (London: Cruikshank and Jewett, 1883), p. 29.

[11] Nichols, p. 3.

(5) NOLA, a bell similar in size to the Codon. This term, however, was also applied to the smallest kind of bell. It took its name from Nola, a town in Campania in Italy, where it has been thought that bells were first invented.

(6) CAMPANA, which really means a bell of large size, was made of brass and suspended in a turret for the purpose of calling people to church.

(7) SQUILLA, again meaning a little bell. The word is of Italian origin and appears in the writings of early Italian poets.

(8) KROTALON or CROTULUM, a small, closed, spherical bell such as those used for horses, sheep, etc., and really more of a rattle than a bell.

(9) SIGNUM, literally "a sign." A large tower bell.

(10) CORRIGUINCULA, used when the monks were to undergo discipline and to summon them at the time of scourging.

(11) CYMBALUM, a bell for the cloisters.

(12) NOLULA or DUPLA, a bell used in a clock.[12]

The Italian word for bell is "campana," the French "cloche," the German "glocke," and the Scandinavian "klokke." A very close resemblance is to be found with all of these to the Gaelic word "clog." All of the latter four words were evidently derived from a common root, most likely the Latin "clocca." In the Chinese Manchu dialect there are two words for bell that are onomatopoetic, being "tsiang-tsiang" and "tang-tang." The last one certainly is on a par with our "ding-dong."

The making of early bells, that is as far as the Christians are concerned, was an art that was placed in the supervisory hands of the clergy. St. Patrick came from Gaul to Ireland about the year 400 A.D. and brought a crew of skilled workmen and a number of bishops. Dr. Coleman writes, "among these workmen were metal-smiths, bell

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[12]Lefevere, pp. 5-7.

makers, and braziers. Designation was made by St. Patrick that 'the smiths should make bells, the braziers patens[13], and the ministers the altar chalices.'"[14]

These early Irish bells were, of course, not cast as our modern bells are, but were made of thin plates of beaten metal, bent into a four-sided shape, riveted along the sides, with a handle placed at the top. The cow-bell, familiar to us at the present time, is probably the best example of the early type of Irish bell. The best bells of the lot were dipped into a solution of molten bronze, filling in all the cracks and doing an excellent job of coating the bell, making it more solid and resonant. These early bells, most of which are now in museums, show indications that they were rung by being struck with a hammer or small mallet. It is apparent that the clapper was added at a later period. When the clapper was finally tried, it was found to be considerably more convenient as well as giving a much more pleasing tone to the bell. As a result clappers were added to most of the old bells.

The Irish have greatly revered sacred relics and preserved them so carefully that many of these bells have been handed down for over a thousand years. Fifty or sixty of them are now in existence. If the Irish had not had such reverence, we would know very little today of the first Christian bells.

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[13]Small silver tray-like repositories used as a temporary resting place for the **Host** in the Roman Catholic Mass.

[14]Coleman, p. 77.

The Encyclopedia Britannica states that, according to the writings of The Venerable Bede, church bells were introduced into England in about 680 A.D.[15] Gouverneur Morrison says that "Turketul, the Abbot of Croyland, put the first peal of bells into a British belfry early in the eighth century. He first presented to the Abbey a large bell called 'Guthlac,' and later added six others named 'Pega,' 'Bega,' 'Bettline,' 'Barthollmew,' ' Tatwin,' and at last, one named after himself, 'Turketul.'"[16] Apparently gifts of bells to churches and monasteries became very common at about this same time.

The earliest dated bell in England is at St. Chad's, Claughton, Lancashire, and is inscribed 1296. In France the oldest existing bell, which is now in the Museum of Bayeux, is dated 1202, and in Italy, in the famous Leaning Tower of Pisa, are two bearing the dates 1106 and 1154.

As we have said, the form of the early Irish bells strongly resembled our modern cow-bell. The other basic forms in common use at that time--the sixth and seventh centuries--were the little bell, or tintinnabulum; the inverted cup or vase style, which was round headed and of the same thickness from top to bottom, with a finger ring at the top and a clapper suspended underneath the head; and finally, the primitive convex bell with a metal ring fixed to the top, sometimes taking the shape of what was known as a "beehive" bell.

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[15] James R. Lawson, "Bells," Encyclopedia Britannica, 14th. ed., Vol. II.

[16] Gouverneur Morrison, Bells: Their History and Romance (Pasadena, California: J. F. Rowny Press, 1932), p. 89.

During the eighth and ninth centuries the casting of bells was begun on the continent. This was the particular era of the primitive bell, and France, England, the Low Countries, and Italy all provided material to the various stages of its development. Arthur Lynds Bigelow, carillonneur of Princeton University, feels that one of the most important features in the development of the bell--the addition of a ring of metal at the lip--occurred at this time.[17]

The addition was certainly a logical step. The bell, cast for the most part in bronze, and in the usual convex shape, had a tendency towards brittleness and was very apt to shatter from the blow of a clapper on the inside, or the stroke of a hammer on the outside. It was necessary to add the metal ring to enable the bell to withstand the shock. This was, of course, a strictly practical change; however, the resulting change in the tone of the bell must have been noticed immediately. From that time on, no bell has been cast without this extra lip of heavier metal. Among bell-founders today it is well known that the strike-tone--the fundamental tone of the bell--depends on the thickness of this lip.

In the early part of the thirteenth century, the bell made a definite break away from all the existing forms. The waist of the instrument was changed from convex to concave. There was no change whatsoever in the head which remained spherical as it had been in the primitive bells. The lip now became a bulge of significant size

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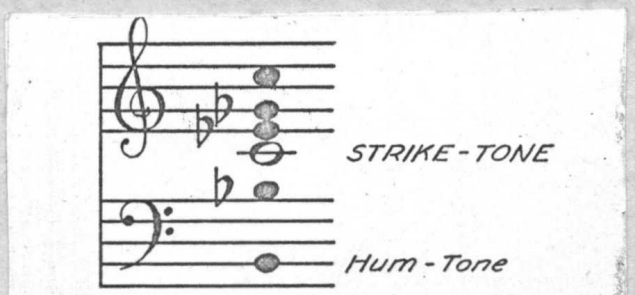
[17]Arthur Lynds Bigelow, Carillon (Princeton: Princeton University Press, 1938), p. 32.

and was brought to a sharp edge on the underside, a characteristic which still remains today. Dr. Bigelow goes on to say, "This was, and still is, the archaic bell, found everywhere from Italy to the British Isles and even in Scandinavia. Its tone is richer, fuller, and of greater carrying power than the primitive bell. It is, however, too long and too thin for its diameter, with the result that the tone is often clangy and somewhat hollow and long-vibrating."[18]

The tone of the bell consists of several partial tones which may be either in a pleasing or discordant relationship. If they are completely consonant the bell may be said to be pure. The tonal series of the archaic bell may be written out thus:



THE TONAL SERIES OF THE ARCHAIC BELL

When two or more of these bells are sounded together in a chord the effect is a jumble, and the clang of tones and over-tones is nerve wracking. To add to the confusion, archaic bells are never tuned and are not constant in their pitches.

During the last years of the fourteenth century the traditional lips became established. The English lip is curved

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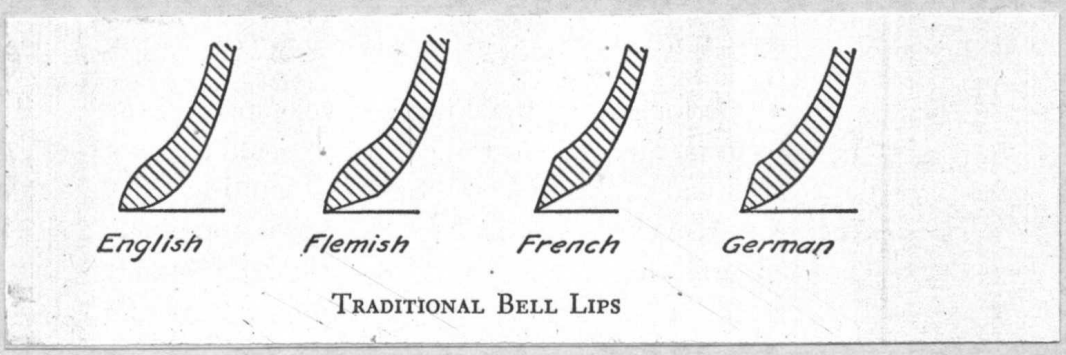
[18] Ibid.

both inside and out; the Flemish, curved on the outside but flat inside; the French, either straight both inside and out, or else slightly rounded on the outside; the German, much like the French, except that it is often rounded on the inside like the English. The accompanying sketch is far more adequate than words in describing these various lips and rims.



TRADITIONAL BELL LIPS

Around the beginning of the fifteenth century the cities of Flanders were in the midst of their "golden period" of history. The highly cultivated musical sense of the Flemish was applied to the bell, and their knowledge of tone was brought to the foreground in perfecting the instrument. They decided that a long step in the right direction would be taken if they could make the bell sound its octaves--there should be three in every well proportioned bell, according to Flemish founders.

The instrument was shortened and, for the first time, was made with broader shoulders, which became increasingly more important. This change altered what had up to this time been a series of discordant overtones. The partials seemed to re-arrange themselves in a much more harmonious sequence. It was further learned that when the harmonic series was at its very best the bell had a third

(which was minor) just above the strike-tone, and a fifth (which was a perfect interval) above the same strike-tone. Having this knowledge, it was a simple step to change the methods of casting. Guess work on pitch was virtually eliminated by casting the bell somewhat thicker than necessary and then turning or chiselling the inside on a lathe until the principal tone was true and the partials in good relationship. Once the final perfection of tone was established, founding and tuning of bells for carillons became an important business in the lives of the people of the Low Countries. The names of Van den Gheyn, Hemony, Pettit and Fritsen are still prominent in the field of bell-casting, even in this century.

Since the carillon will be considered in a chapter by itself, it seems proper to close this section with a brief summary of the various functions performed by single bells during the time they were being developed into our modern instrument. Dr. Coleman has given a very thorough accounting:

(1) AVE MARIA - Tolled every day at six and at twelve, each person, whether in the street or in the house offering a prayer to the Blessed Virgin upon hearing it sound. The function of the Ave Maria was later taken over by another bell signal called the Angelus.

(2) SANCTUS - Used in the Catholic Mass to call the worshippers attention to the more important parts of the liturgy. This has now been replaced by the smaller hand bell.

(3) GABRIEL - Rung early in the morning to awaken the people of the parish and prepare them for their daily tasks.

(4) PUDDING - Rung directly after worship as a sign to begin serving the Sunday meal.

(5) PASSING - Tolled when anyone was dying. All persons within its hearing were supposed

to offer a prayer for the soul of the dying. In some places it was customary to repeat a certain number of rings at the end of the tolling. The most common signal was three rings for a child, two times three for a woman, and three times three for a man.

(6) ANGELUS - The call that eventually superseded the Ave Maria. This bell was rung at six in the morning, twelve noon, and six in the evening. The ring itself was three strokes repeated three times. The custom is still prevalent in many European countries.

(7) CURFEW - Introduced all over England by William the Conqueror. Rung at eight in the evening when all people were ordered to cover their fires and extinguish all lights in the house. The original was called "couvre-feu" in the French, and eventually came to be "curfew."[19]

One age-old custom still prevailing in Europe is that of completely silencing the bells for the entire week preceding Easter. No sound is heard until midnight on Holy Saturday, when all the bells in the country begin to ring.

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[19]Coleman, p. 182.

CHAPTER II

BELL FOUNDING AND TUNING

With additional references to Inscriptions and Baptism

Casting (or "founding") is of primary concern when the general subject of bells is under consideration. Under the head of "casting," it is possible to have four subdivisions: (1) bell metal and its specifications, (2) shape and proportions of a good bell, (3) the techniques of casting, and (4) the tuning of bells. Taking these in order, our attention focuses first on bell metal and its specifications.

Grove's Dictionary provides the following information: "Bell metal is an alloy of copper and tin and is a species of bronze. In bronze, density and hardness are increased by combining softer and lighter metals. Copper becomes a great deal more sonorous in combination with tin."[1] The small "crotal" bells discovered by Layard in Assyria were made of copper and tin in the proportion of ten to one respectively.

In some cases where analyses of old bell metal have been made, there have been found traces of zinc and lead. These metals are not and never have been component parts of the traditional alloy. A good guess is that they were probably traces of impurity that were

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[1] Grove's, loc. cit.

found in a great many of the earlier metals. Still another theory is that during the time when bells were frequently cast in churchyards, pewter was occasionally melted down together with old copper kettles to form the alloy. Since pewter contains a small quantity of lead, and copper kettles as a rule contain some zinc, this is one way in which the small portions of these metals could have gotten into some of the older bells.

There is an erroneous idea that silver and gold have been used in compounding an alloy for bells. The basis for such a theory may very well be traced to the custom of throwing gold and silver coins into the molten metal as it was being blessed by the priests. Gold actually has about the same resonance as lead, and a silver bell, although having a pleasant tinkling sound, could hardly be classified as sonorous. Neither of these metals would be particularly useful as a contributor to the sound of a good bell.

As a matter of actual fact, bells have been made of steel. They were found to be short on tone, more noisy than musical, defective in carrying power, and requiring an extremely heavy blow to set them vibrating. Bells have been made of glass, but as might be expected, were unable to withstand the continued use of a clapper. In the final analysis we can only say that bell metal must be elastic, tough, and hard enough to be durable. Consulting Grove's Dictionary again, we find, "The best alloy to secure maximum response, resonance and durability is pure copper and tin in the proportion of thirteen to four respectively. This proportion by

the way, has been agreed upon by several authorities."[2]

As far as shape and proportion are concerned, the most important fact to be remembered is that the quality of tone produced by a bell must be governed by the purity of its alloy and by the bell's shape, height, thickness, and width. The approved design of a good bell is the result of the accumulated years of experience of many founders. The proportional factors may be presented as follows:

Thickness of the sound bow	1
Diameter of the mouth.	14 to 15
Diameter of the shoulder	7 to 7½
Height	12

The Meneely Bell Company of Watervliet, New York, publishing a statement concerning their own specifications--which coincide exactly with those given above--informs us:

> The scientific proof as to why this particular form should be the best is yet to be set forth. The approved form, however, cannot be deviated from without injury to tone and tune. Details are delicate and the variation most intricate.
>
> These secrets the bell-founder keeps to himself, because the allowance which must be made for tuning, while yet maintaining the best proportions are the result of long experience which cannot be taught.[3]

The actual casting of a bell is probably the most complicated, and at the same time the most interesting detail of all. A "cast bell" is nothing more than a layer of metal which has been run (in a molten state) into an open space between molds. The inner mold is called the "core," and the outside is called the "cope."

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[2] Grove's, loc. cit.

[3] Coleman, p. 102.

In comparing an early method of casting with the techniques used in our own century, we find that the process itself has changed very little. Dr. Coleman tells us of an old method:

> A block of wood was first cut the exact shape and size to fill up the inside of the bell to be cast. The core was then covered with wax which was exactly as thick as the bell was to be. This was the wax model. Outside the model came the cope, made of clay or hard earth, which would hold its shape when dry. When the earth was quite dry, the wax was heated until it melted and was allowed to run out. The cavity, which was the shape of the wax model, was then filled with molten metal from the furnace and was allowed to cool. If a design or ornament was desired on the outside of the bell, the design was made of strips of wax laid on the wax model before the earthen cope was put on. The same design appeared on the metal.
>
> A modern bell-maker would think this method to be somewhat old-fashioned, but in the early days of bell-founding it was considered very wonderful.[4]

A later method made it possible to produce better and even larger bells. The following is an interpretation of the general procedure by which most of the large bells still in existence were made.

Instead of the core being made of just a block of wood, as in the previous description, a framework of bricks was built, completely hollow inside, so that a fire could be made under it. Over this framework, a layer of clay was shaped to the desired form for the inside of the bell. This entire core was made to revolve on a spindle, resembling somewhat the traditional potter's wheel. To scrape off the surface of the clay and to "turn" the exact shape desired, a crook was fastened to the spindle and performed the task admirably.

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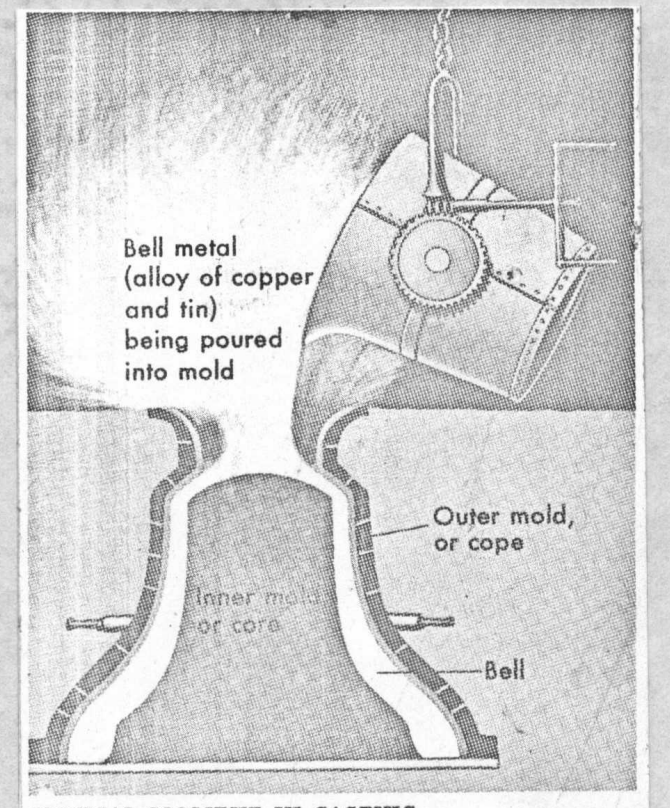
[4]Coleman, pp. 64-65.

When the core was dry it was smeared with grease. Upon the greased core the "false bell," or model, was made of plastic clay. A larger crook was made and fastened into the top of the spindle. As the spindle turned, the crook made the outside of the clay model smooth. Many bells show a set of "bead" lines around the outside, caused by the revolving crook that shaped the clay bell.

Inscriptions and ornaments were molded in wax on the clay model. When quite dry, the whole piece was smeared with grease to keep the next layer from sticking to it. Fine clay was put over this very carefully so as to fill up all holes and cracks in the design. Then a layer of coarse clay was applied and the solid cope was formed.

A fire was made under the core and everything baked hard. All layers of grease, as well as the wax inscriptions, had to be steamed out, leaving a little space between the model and the clay forms above and beneath it. With this procedure the model was made loose enough so that it came out easily, and leaving its exact shape in the hollow space between the core and the cope. The molten metal



CRITICAL MOMENT IN CASTING
Casting a bell is a very difficult process. The slightest flaw, such as an air bubble or a tiny crack that comes as the metal cools, may ruin the bell's musical note or pitch.

was then poured into this cavity.[5]

To bring this process a little more up-to-date (1925) The Meneely Company contributes the following information:

> Porous loam and other substances compose the material which is put upon the cases in varying thicknesses, to which the necessary forms and finishes are given by the use of sweep-patterns, shaped in such a manner as to secure surfaces corresponding to the outer and inner portions of the intended bell by their revolution around a common center.
>
> As bell metal shrinks in cooling, the inner case is wrapped with straw rope before the loam is placed upon it. The charring of the rope, by the heat of the metal in pouring, gives room for the necessary contraction and prevents the straining of the metal.
>
> The molds are closed upon each other in a manner securing exact regularity of thickness in the inner space. The metal is then poured in at the head. The gasses generated in the metal find vent in the resulting perforations. If they were allowed to remain in the molds, they would produce an explosion, or at least cause a porous casting.
>
> These cases allow the bell to cool after casting in such a way as to secure precise uniformity throughout.[6]

The actual casting of a bell takes only a few minutes, but preparation for it often takes many weeks of hard and careful labor. Large bells, such as the huge forty-thousand pound "Bourdon" bell in the Laura Spelman Rockefeller Carillon in Riverside Church, New York City, are cast in deep pits. Here again problems often arise. If the mold is damp, or not of a proper temperature, or if gasses collect and cannot escape, the bell may very well be porous or easily cracked. In the case of very large bells, they may require a week or more to cool before being removed from the pit. A bell weighing a ton would be too hot to touch for at least two or three

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[5]The details were compiled from the writings of Dr. Coleman, Dr. Bigelow, Gouverneur Morrison, J. R. Nichols, Ernest Morris, and J. Smits van Waesbergh.

[6]Coleman, p. 110.

days, but one weighing only five-hundred pounds could be dug out the day following pouring. When a bell cracks, or is found to be too porous, it may be broken up, melted, and re-cast. This was the case with England's original "Big Ben," and with our own Liberty Bell, which was re-cast twice.

The final step in the routine of bell-casting is the tuning. This procedure demands experience, scientific knowledge, and the possession of an ear which responds to extremely slight differences in pitch. William Gorham Rice writes, " . . . Van der Straeten compares a fine bell to a violin by Stradivarius--the only difference being that once the bell is tuned it remains so forever."[7]

The actual mechanical operations of tuning are practically a trade secret and are very carefully guarded. The following article from the London Daily News, quoted in its entirety by Rice, gives what seems to be a fairly accurate description of the process.

> Primarily it can be said that the pitch of a bell has direct relationship to its interior diameter. The greater this diameter the lower will be the note. Exterior and interior curves, composition of the metal, its temperature at casting and cooling are also elements in the casting of a perfect bell. Yet it is by varying the interior diameter that its pitch is chiefly affected.
>
> When a bell is to be tuned it is placed, resting on its crown, on a special vertical lathe, having a revolving platform above which is a rigid, but adjustable arm extending downward into the inverted bell and holding a cutting tool. The platform with the bell firmly bolted to it is then set revolving, and by a proper adjustment of the arm and cutting tool, circular shavings of metal can be turned off from any part of the interior of the bell.

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[7]William Gorham Rice, Carillon Music and Singing Towers of the Old World and New (New York: Dodd, Mead & Company, 1930), p. 230.

> It is always intended that a bell shall come from the mold so as to give a note slightly above that called for in the specification for that particular bell. In other words, that it shall have, as molded, a diameter less than it is to have when finally tuned and finished. The endeavour is to always err on the safe side and give an excess of metal in certain portions of the interior of the bell. All this because tuning generally consists of flattening the pitch of the bell by turning off shavings of metal by the process just described.
>
> Just at what points these shavings are to be removed and how thick the shaving shall be is, in large measure, the secret of tuning. Sharpening the pitch is also possible, but to a very slight degree only, by turning off metal from the extreme bottom, or rim, of the bell, thus lessening its diameter at that point. But such cutting the rim shortens the height of the bell and is extremely dangerous since any change of this kind may seriously injure the timbre of the instrument.[8]

The first five tones of the modern bell's own peculiar harmonic structure must be present in each individual instrument, if it is in good tune. The names of these five tones (together with their musical intervals) are as follows, beginning with the lowest tone of the series:

(1) HUM TONE - A perfect octave below the strike-tone.

(2) STRIKE-TONE - The fundamental tone of the bell, heard as the most prominent member of the series at the instant of the strike. It is from this tone that the other tones are tuned.

(3) THIRD - A minor third above strike-tone.

(4) FIFTH - A perfect fifth above strike-tone.

(5) OCTAVE - A perfect octave above strike-tone.

Rice says, "An exceptionally fine bell will have the next two tones of the harmonic series (of the bell) also in good tune, that is the upper third (a major tenth above strike-tone), and the high fifth

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[8] Ibid.

(a perfect twelfth above strike-tone). The second octave above strike-tone is also frequently present."[9] These tones, which are the sixth,seventh, and eighth members of the bell's partial series, are to be found in tune not only in the best bells of present day founders, but also in the best Flemish bells of the seventeenth century, especially those made by Frans and Pieter Hemony.

Although the oldest bells are not always dated, they have upon them some interesting remarks and inscriptions. These mottoes were, in the early years, undoubtedly apropos, however, in the course of time they deteriorated and became frivolous and out of place.

One inscription, which is the only one of its kind in existence, is the one on the fourth bell of St. Mary the Virgin at Oxford. Around the crown are these words:

"Be ẏt knowne to all that doth me see
That Newcome of Leicester made mee. 1612."

Below this inscription are two lines of music on a five line staff. The "C" clef is used for three sections and the "F" clef for one. The notes are diamond shaped and there are no bar lines. The signature is one flat. The accidentals--flats--are placed before the notes in the usual manner, but the sharps are above the notes, and in one instance below. At the beginning of each section of music is a medallion encircled with one of the following legends:

(1) Keep tyme in anye case.
(2) The last strayne was good.
(3) Then let us sing it againe.
(4) Excellent well-songe my herts.

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[9] Ibid.

Nothing has been discovered as to who wrote this music or why it was cast upon the bell.[10]

Some of the bells explained their own particular duties to the community in a very personal manner, as for instance:

"I ring at six to let men know,
When to and from their worke to go."

Another bell of the same period (1645) tolls the following message:

"All men that hear my mournful sounde,
Repente before you ly in grounde."

And one in Oxfordshire, cast in 1667:

"I ring to sermon with a lusty boome,
That all may come, and none stay home."

Another inscription found on a bell of 1652, and which was more or less similar to many other "fire-bells," said:

"Lord, quench this furious flame,
Arise, run, help, put out the same."

Healthy humor was often found on bells, as this, cast in 1700, shows only too well:

"All of you in Bath that hear me sound,
Thank Lady Hopton's hundred pound."

On a bell of St. Benet's, Cambridge, one of a peal of six that is dated 1607, is found:

"Of all the bells in Benet I am the best,
And yet for my casting the parish paide lest."

The famous bell "Roeland," the largest bell in the carillon of Ghent, Belgium, has the following inscription, translated from the Flemish by Dr. Coleman:

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[10] Grove's, loc. cit.

"My name is Roeland, when I clap there is a fire;
When I toll there is a storm in Flanders."

Coleman also says that "this bell was once dismounted by order of Charles the Fifth, after being convicted of having played a very turbulent part with its 'tongue' during the Flemish Insurrection."[11]

These by no means constitute the entire collection of inscriptions found on bells, but I do think they are a few of the best.

One of the most extraordinary features of a bell's career was the entire process of Christian baptism of the bell, including naming, anointing, sprinkling, sponsors, and every other outward sign which marks the acceptance of human beings into the church family. The principal purpose involved in the baptism of bells was to endow them with power to act as preservatives against thunder and lightning, hail and wind, and storms of every kind, so that they might drive away evil spirits.

Even at the present time, the dedication of new bells is nearly always accompanied by reverent ceremonies and rejoicing. It is not actually known when the baptism of bells began, but it has been said that it originated under Pope John XIII about 970. Rice argues against this dating and says that it must have "prevailed long before that time, since The Capitulars of Charlemagne (A.D. 789) proclaim that the baptism of bells was strictly forbidden."[12]

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[11]Coleman, p. 277.
[12]Rice, p. 68.

CHAPTER III

A FEW OF THE WORLD'S GREAT BELLS

Some of our best-known and most celebrated bells have achieved their fame primarily because of their size and weight. Others, on the other hand, are noteworthy because of their participation in some important historical event. This chapter is devoted to brief notes and discussion of just a few of these instruments.

England's greatest bell is "Great Paul" of St. Paul's Cathedral in London. It heads the British weight list with an impressive sixteen and three-quarter tons. "Great Paul" was cast by Taylor of Loughborough in November of 1881. Eight hours were required to melt the twenty tons of metal necessary, and the bell mold was filled within four minutes. The casting was allowed six days to cool before it was removed from the pit. The bell, which cost about fifteen thousand dollars, has the following dimensions:

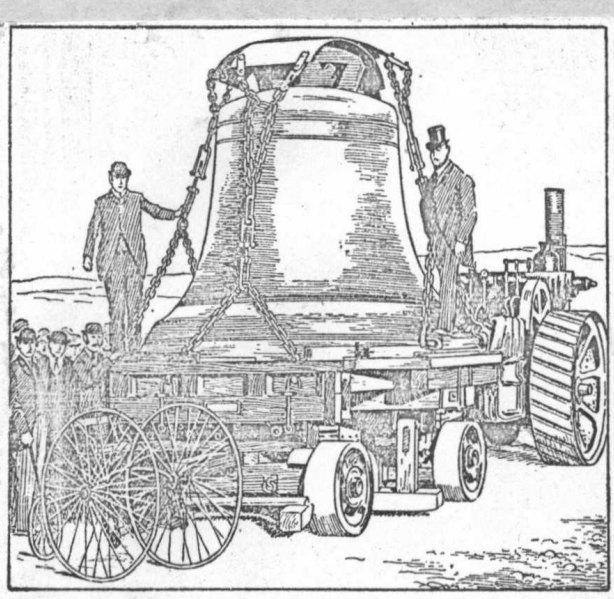

FIG. 5.—*Great Paul*, of St Paul's cathedral, London, the largest bell in Great Britain (16¾ tons), en route from Loughborough, Leicestershire, in May 1882 (from a contemporary photograph).

Height . . . . . 8' 10"
Diameter . . . . . 9' 6¾"
Thickness at sound bow . . . 8¾"[1]

The second largest English bell is a secular one, the hour bell at Westminster, known to most of us as "Big Ben."

"Big Ben" was first cast at the village of Norton on August sixth, 1856, by Mears of Whitechapel. Shipping problems forced the caster to send the instrument overland to Hartlepool, and then by sea to London. Shortly after the bell arrived at Westminster it was cracked. After the unfortunate incident it was broken up and re-cast in 1858, once again by Mears. On the re-casting the weight was reduced by two tons. Both the first and second designs were by E. B. Denison, bell architect of Mears. The inscription reads as follows:

> This bell, weighing 13 tons, 10 cwt., 3 quires, 15 pounds, was cast by George Mears of Whitechapel, for the clock of the Houses of Parliament, under the direction of Edward Beckett Denison, Q. C., in the 21st. year of the reign of Queen Victoria, and in the year of our Lord MDCCCLVIII.[2]

Unfortunately, shortly after hanging, "Big Ben" cracked under the pressure of an unusually heavy clapper blow. This crack was never repaired and accounts for the dull sound of the bell even to the present day.

Crossing the channel to Ireland we come again to the bells of St. Patrick. The "Bell of St. Patrick's Will," known also as "Clog-en-eadhacta Phatraic," is formed of two plates of sheet iron, fastened together by iron rivets and bronzed. An iron handle is

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[1] "Bell," Chambers's Encyclopedia, 5th. Ed., Vol. II.
[2] Grove's, loc. cit.

attached to the top of the bell. Its dimensions are:

Height . . . . . 6"
Breadth at the shoulder . . 4¾"
Breadth at the base . . . . 5"

It is believed that this bell is the one mentioned in the Annals of Ulster, c. 552 A.D., which was removed from St. Patrick's tomb by St. Colomille.

In keeping with the custom of the Irish, this bell is kept in a case, or "shrine," which bears an inscription in Gaelic that the shrine itself was made between the years 1091 and 1105. The framework of the shrine is formed of bronze plates, to which the elaborately decorated portions are fixed with rivets. The handle portion is of silver with enamelled settings and scrollwork. The compartments in the frame retain decorations of gold filigree and interlaced work, and around the front were originally eight settings of red stones, four of which are now missing. The crystal in the center and the one below it are later work. The sides are covered with additional interlaced ornaments, and the back is overlaid with a silver plate of a definite cruciform pattern.[3] The "Bell of St. Patrick's Will" is shown in a photographic print in the appendix.

A place of importance among the world's great bells must be given to "Tsar Kolokol" (often called either "King of Bells," or "The Empress Anne's Bell"), the great bell of Moscow's Kremlin.

The "Tsar" was cast in 1734 by Michael Motorine, during the reign of Empress Anne. It was made partly from the metal of an

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[3]Coleman, p. 44.

earlier bell cast in 1654 that weighed nearly one hundred and thirty tons. One hundred and seventy-two thousand pounds of additional metal were used in casting the new bell. In spite of its gigantic size, J. R. Nichols says, " . . . this bell was once suspended (that is the original bell of one hundred and thirty tons), and even rung--an inscription on the present bell states this fact about its predecessor--necessitating the employment of between forty and fifty men, half of whom stood on each side."[4]

The weight of the present "Kolokol" is given by Russian authorities as four hundred and thirty-two thousand pounds. This is an approximation, of course. The principal dimensions of the "Tsar" are the following:

Height . . . . . 19½'
Diameter . . . . . 22½'
Thickness at the sound bow . . 23"

In 1737 a fire broke out in a part of the Kremlin adjacent to the portion containing the bell. The wooden building intended to serve as the belfry burned, and the huge mass of metal fell and partially sank into the ground. As it fell a fragment seven feet high broke away from the body of the bell. The "fragment" alone weighed eleven tons!

The story of the raising of "Tsar Kolokol" is best told in the words of the Magazine of Popular Science of 1839:

> In the month of July, 1836, a successful attempt was made to raise the enormous bell which had been so long buried in the earth in the Kremlin, at Moscow . . . M. Montferrand, a gentleman greatly distinguished in Petersburg by the numerous works he has executed was entrusted with the direction of the operations.

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[4]Nichols, p. 32.

> As the bell was lying in a cavity in the ground, and more than thirty feet below the surface, a large excavation was made to clear it. Over this was constructed a strong and lofty scaffold for the attachment of the blocks, and for the temporary suspension of the bell at the proper height. At half past five in the morning, the authorities of Moscow and a large number of spectators being assembled on the spot, prayers were offered for the success of the attempt and the operations commenced on a signal given by M. Montferrand.
>
> Six hundred soldiers instantaneously set to at a large number of capstans. The enormous weight was mastered and the bell was seen to rise slowly in the pit. Forty-two minutes elapsed during the elevation to the necessary height, no accident occurring.
>
> The first operation being finished, the next was to build a platform beneath the suspended bell. This was completed in eight hours, and the bell was lowered upon it. On the following day, it was placed upon a sledge and drawn, by means of an inclined plane, up to the pedestal intended to support it, and there finally left, on the 26th. of the same month.
>
> This colossal work of art is, after all, but a mere curiosity. Its use as a bell is impossible, from a fracture, about seven feet high and two feet wide, in the lower part, where it is twenty-three inches thick. The cause of this injury rests entirely upon conjecture.[5]

At the present time "Tsar Kolokol" serves the Kremlin in the capacity of a shrine, although no one knows to whom it is dedicated.

Russia possesses other bells of considerable weight, including one of one hundred and seventy-one tons at Trotzkoi, and another weighing one hundred and ten tons at Moscow, in addition to further bells of great size, which exceed by far the weight of the heaviest bells of this country. It is almost impossible to state how these Russian bells have fared under the present communist regime. The Soviet Embassy, however, was most cooperative in providing written material and photographs.

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[5] Ibid.

In a pagoda at Mingoon, Burma, is a great bell of eighty-seven tons, and in China there are many others, including the great bell of Peking, weighing fifty-three tons. Cologne cathedral has one of twenty-five tons, Lisbon cathedral one of twenty tons, and Paris cathedral one of nineteen and one-half tons. At the great cathedral of Notre Dame (also in Paris) there is a Bourdon bell weighing thirteen and one-half tons that is still rung by the ancient treadle system.[6]

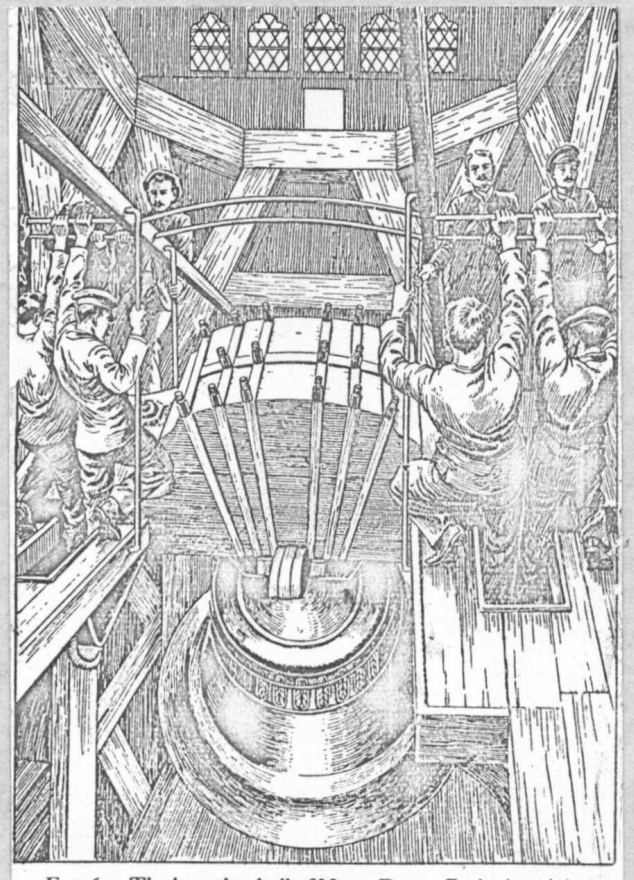

FIG. 6.—The bourdon bell of Notre Dame, Paris; it weighs 13½ tons and is rung by treadles (from E. Morris: *History and Art of Change Ringing*).

One bell that must be mentioned before we leave the subject is the "Liberty Bell." Although it is most certainly insignificant as far as the matter of size and weight is concerned, it is probably the one bell in America that is known to every citizen--man, woman, or child.

This famed historic bell has the following vital statistics:

Circumference around the lip	12'
Circumference around the crown . . .	7' 6"
Height from lip to crown	3'
Diameter over crown.	2' 3"

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[6] Grove's, loc. cit.

Thickness at sound bow . . . . . 3"
Thickness at crown . . . . . 1¼"
Weight . . . . . 2,080 Lbs.[7]

The inscription reads:

"Proclaim Liberty throughout all the
Land unto all the Inhabitants thereof."
--Lev. XXV, 10.

And below this is inscribed:

"By order of the Assembly of the Province
of Pennsylvania for the State House in
the City of Philadelphia."

The original bell was ordered in 1751 by the Provincial Assembly for the new State House--now Independence Hall--which was then nearing completion in Philadelphia. It was cast in London by Thomas Lister. The bell arrived in Philadelphia on September 1, 1752, but was cracked by the stroke of the clapper as it was being tested.

It was re-cast immediately by Pass and Stow, local bell-makers, who added one hundred and ninety-five pounds of American copper to the original metal in the hope of making the bell less brittle. This second bell proved to be defective too, and it was re-cast a second time. The third bell was hung in the State House in June of 1753, and was rung for the first time in August to announce the convening of the Assembly.[8]

Probably the most famous occasion of which the bell was heard was on July 8, 1776, when the Declaration of Independence, which the Continental Congress had adopted on July 4, had its public proclamation.

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[7] "Liberty Bell," Encyclopedia Americana, 1st. ed., Vol. IX.
[8] Ibid.

After an absence of four years (1777-1781), during which it remained hidden to prevent its capture by British troops, the bell was replaced in the State House tower.[9] As it was ringing on the occasion of Washington's birthday in 1846, it suddenly was cracked beyond repair. It was taken down and now hangs in a wooden frame above a small platform in the rotunda of Independence Hall.

Of course, some of the other great bells of the world have been neglected here, since it would be impossible to list them all and remain within the confines of the thesis. It is my own personal feeling, however, that some mention should be made concerning the very beautiful-sounding mission bells of Southern California. Many of these small "tintinnabulae" are reputed to have a tone that surpasses all other bells, regardless of size. The carillon of porcelain bells at Meissen is described as having "the purest bell tone one could imagine."[10]

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[9] Ibid.

[10] Grove's, loc. cit.

CHAPTER IV

THE SCIENCE OF ENGLISH CHANGE RINGING

The question has frequently been asked, "Why has England not, until recently, developed her own perfect bell?" British founders were very close to perfection around and during the fifteenth century, since the proportion of their bells were much better at that time than at any later date. As a matter of fact, a few bells that remain from the earlier centuries have recently been tuned with surprising results. The English never felt any particular desire to hear their bells in harmony. They decided that the only thing really needed was tone. That particular notion became the basis for "change ringing." As to any sociological implications that may have prompted Britain in her adoption of the technique, I must say here that I have found no mention in any of the works studied that would give any indication of "change ringing" being anything more than a method of bell-ringing, and a departure from the more traditional carillon.

From about the middle of the thirteenth century, the English churches had guilds of ringers trained to peal the bells for their services. These "ringer's guilds" discovered that the bells didn't need to be rung all together. They might more easily be pealed in turn, one bell at a time. There could be an order to the ringing, however, as we will see later in the discussion of the different sequences. The name "change ringing" came about simply because

each time the bells were rung, the order of their ringing was changed.[1]

This change ringing is but one facet of the history of the bell. In Northern Europe bells are swung about frame high by means of levers or wheels attached to the head stocks. No sequence is attempted and the result is, more often than not, a jangle. The bells are tuned in accord with each other, however, and even if they do clash together the result is not total discord. In Russia and in Eastern Europe bells are rung by means of levers attached to the stock, and in some instances the ringers go up on the church roof or into the bell chamber and strike the bells with hammers. They may also, with short ropes attached to the headstocks, swing them over and over. In America bells are usually hung in chimes of eight to twelve and are played from a keyboard after the style of the small Flemish carillons. In the Far East no bells have inside clappers, but the huge pagoda and temple bells are struck on the outside by gigantic beams which are swung on chains or ropes. We can easily see, then, that in no country save England is there a method of ringing so precise or demanding.

Change ringing was, in a way, responsible for limiting the sizes of bells in the English belfries. If the bells were too big they could not easily be used in a peal, since it frequently took too many men to maneuver them. When new bells were installed change ringing was kept uppermost in the minds of the men responsible, and no bell could go beyond a certain weight. Bigelow writes, "English

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[1]Bigelow, p. 50.

belfries thus became quite standardized, and peals of eight middle-sized bells were the sign of a well established church, though the smaller towers might house five; and larger ones, more recently, as many as twelve."[2]

Everything in the belfry had to be adapted to the simple manipulation of the peal. The frame was built with the thought of placing all the mounted bells on the same level. The means of hanging the bell and controlling its swing were perfected. In order not to have too much force in one direction at the same time, endangering the stability of the tower, the bells were hung with four of the set swinging in one direction and the others at right angles to them. In spite of this, many of the towers still rock slightly--a constant worry to the novice, but thrilling to the dyed-in-the-wool bell ringer.

A few words ought to be said regarding the hanging of the bells in the tower or belfry prepared for them. The crown of the bell is firmly bolted to the headstock, which revolves on "gudgeons."[3] These gudgeons work in ball bearings. A large wooden wheel is fixed to the headstock, which is grooved for the purpose of holding the rope by which the ringer causes the bell to begin its motion. As the pull increases, the bell describes an ever-increasing arc until its mouth is raised upwards. The clapper strikes the bell's sound bow with each swing until it reaches the end of its movement. The process of getting the bell in this position is called "raising,"

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[2]Bigelow, p. 51.

[3]Pivots.

and in this state the bell is said to be "up" or "set." It may occasionally be allowed to go a little way over the balance until it rests against the "slider stop."[4] It can remain there at rest and the ringer can remove his hands from the rope.

To make it easier for the ringers, bells were cast with a shortened waist so that the heavy mass of metal at the sound bow would be nearer the headstock, meking the bell easier to swing. The English bell thus became broad-shouldered, and possessed a tone that was unknown on the European continent. According to Bigelow, "This one characteristic--the shortened waist--was the principal reason England was unable to reach 'perfection' for three full centuries."[5]

These shortened bells have a series of harmonics that let no two bells strike together without having a certain amount of discord. Since bells were cast as near to the exact tone as was possible, and were exposed to only an occasional tuning for fear of spoiling them completely, there were virtually no two bells with the same series of harmonics, let alone a consonant series.

Coming now to the systems and methods comprising the art of change ringing, we must first understand that they are rung in a most scientific and prcise way. The bells are pulled up to a full revolution at each stroke--a physical exertion that is no simple task. The manipulation of the ropes and the management of

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[4]A device protruding from the side of the bell frame which automatically stops the bell at the top of its swing.

[5]Bigelow, p. 56.

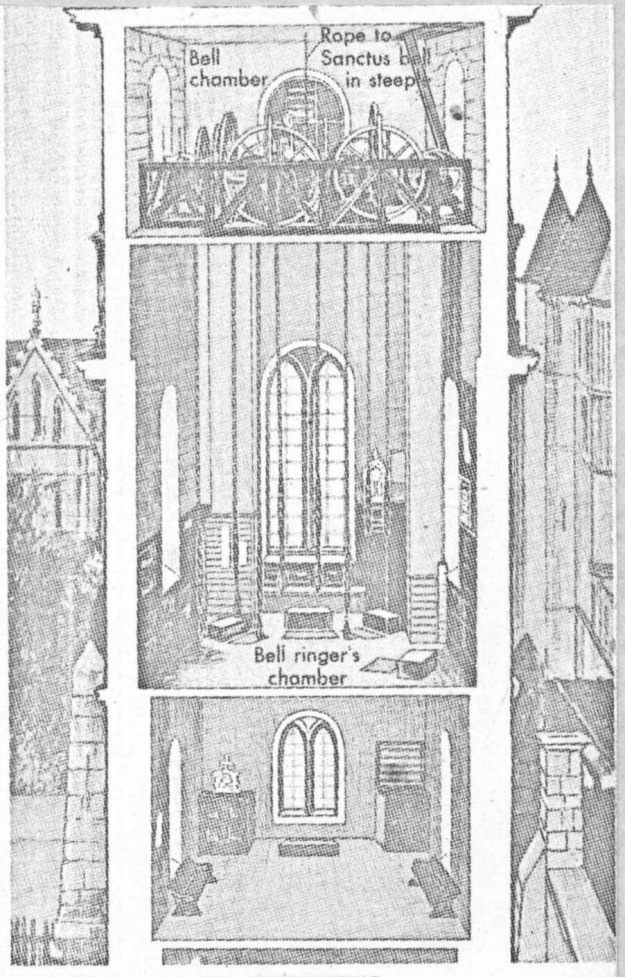
the heavy bells require a quick eye and ear, as well as an excellent judgement in the problem of striking in the proper sequence. Each number in the ringer's system of notation represents a particular bell, and each row of numbers is a "change." The bells strike in order of their appearance from left to right. The fundamental rules which govern the system are:

(1) That there must be an alteration in the sequence of the bells at each successive blow of the clapper.

(2) That a bell can alter only one place either backward or forward at a time.

(3) That the first sequence is rounds.[6]

(4) That the "touch" or "peal" is not completed until the sequence of rounds is reached again.



THE BELLS OF ST. CLEMENT'S
Here is a view inside the tower of the famous bells of St. Clement's in London. Eight bells are attached to wheels in the upper room. The ninth, the Sanctus bell, is in the steeple.

The methods, as they are called are mathematically constructed and so devised that in the succession of changes no two lines are alike and no bell strikes more than twice in the same place in succession. The place of a bell in any row never differs from its position in the preceding row by more than one place to the left or right. Each method has a name indicating its degree of intricacy. Different names are also given to the changes according to the number

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[6]The sequence of all bells from the topmost down, in order.

of bells used. The following chart from Grove's Dictionary names these methods.[7] (The last four columns indicate the length of time it would take to ring a complete change.)

No. of Bells	Name of Ring	No. of changes	Yrs.	Days	Hrs.	Min.
4	Singles	24				1
5	Doubles	120				5
6	Minor	720				30
7	Triples	5,040			3	30
8	Major	40,320		1	4	
9	Caters (Quaters)	362,880		10	12	
10	Royal	3,628,800		105		
11	Cinques	39,916,800	3	60		
12	Maximus	479,001,600	37	355		

The number of possible changes on any series of bells may be obtained by using the mathematical system of multiplying the number of bells together (1x2x3x4x5, etc.). On three bells only six changes or variations can be produced. As may be seen from the foregoing chart, five bells are capable of one hundred and twenty changes , and so on up to the astronomical total of 479,001,600 variations on only twelve bells.

A relay of ringers, according to the Encyclopedia Britannica, rang 40,320 changes in twenty-seven hours at Leeds, Kent, England in 1761. This was not accepted as a true record, however, since it was done by a relay team. The actual accepted record was rung by a single group at Winsford, Cheshire, England that rang 21,600 changes in twelve hours and fifty-eight minutes.[8]

[7] Grove's, loc. cit.

[8] Encyclopedia Britannica, loc. cit.

The technique and skill in change ringing is embodied in three principal tasks--"hunting," "dodging," and "making place." The diagram on the following page illustrates a "plain bob" played on four bells, and shows the path of Number One (treble) and Number Three through the twenty-five rows or changes. Reference to this chart while reading the next paragraph will aid in understanding one of the basic methods of change ringing.

Number one has a uniform path through the rows, leading two strikes--that is, striking first in the first two changes--and then "hunting through," or "stepping forward" one place in each succeeding row. If we follow the path of Number Three we will see that if it continued to "hunt after" Number One--that is, if it exactly duplicated the path of Number One--the bells would come rounds, or 1-2-3-4, after only eight changes. This would be only one-third of the possible number of changes to be had from four bells. Therefore, the "plain bob" method causes Number Three to "make" the Number Two bell's place--that is, take it out of the position it would normally assume--and lead again. This causes the bells behind to reverse places in succeeding rows (e.g. 4 2 - 2 4). The entire procedure continues in this way until rounds ends the sequence.

This same "plain bob" method may be applied to higher numbers of bells, but to produce the greatest extent of changes some other variations are applied. The usual practice, to assist the ringers in memorizing these various methods, is to draw out the path of one particular bell through the "course" in a skeleton outline. Each bell follows the same path, but begins in a different spot. The

DIAGRAM OF A "PLAIN BOB" METHOD ON FOUR BELLS SHOWING PATHS OF TREBLE (1) ON A CONTINUOUS LINE, AND (3) ON A BROKEN OR DOTTED LINE THROUGH THE ROWS OR CHANGES

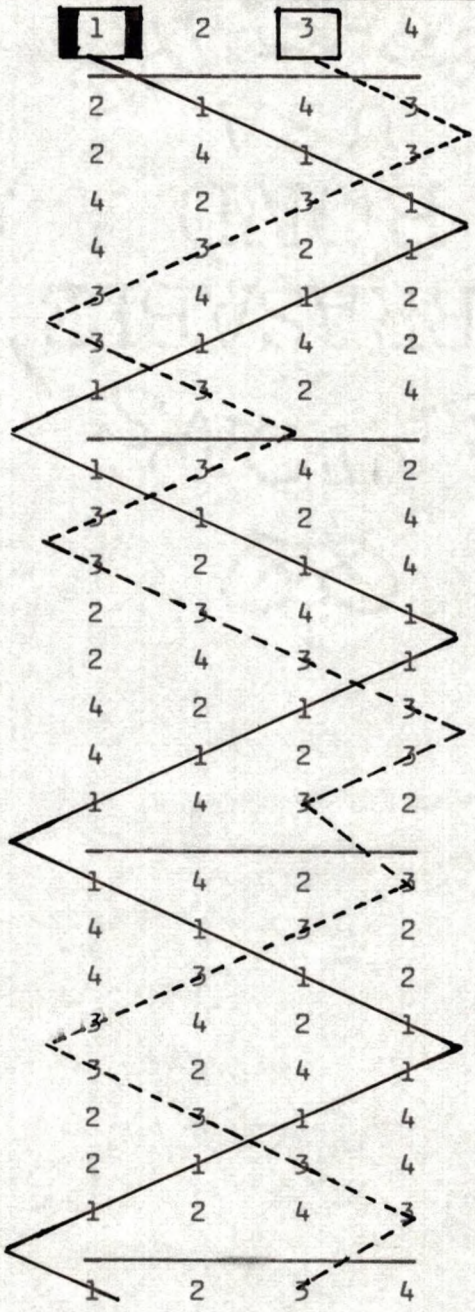

diagram on Page 44 is a good example of such a map.

To go very deeply into the science or art of change ringing would require at least an entire volume. The little presented here gives only one basic system out of hundreds. Just to bring this chapter to a close, however, it may be interesting for the reader to see just how the first ten changes of a straight course of "Grandsire Triples" on seven bells would appear on paper. The set is from Chambers's Encyclopedia.[9]

1 2 3 4 5 6 7
2 1 3 5 4 7 6 (1st. Change)
2 3 1 4 5 6 7
3 2 4 1 6 5 7
3 4 2 6 1 7 5
4 3 6 2 7 1 5 (5th. Change)
4 6 3 7 2 5 1
6 4 7 3 5 2 1
6 7 4 5 3 1 2
7 6 5 4 1 3 2
7 5 6 1 4 2 3 (10th. Change)

Here again the reader will see that the Number One bell follows a steady path with the other bells sometimes steady and at other times "dodging" or "making place."

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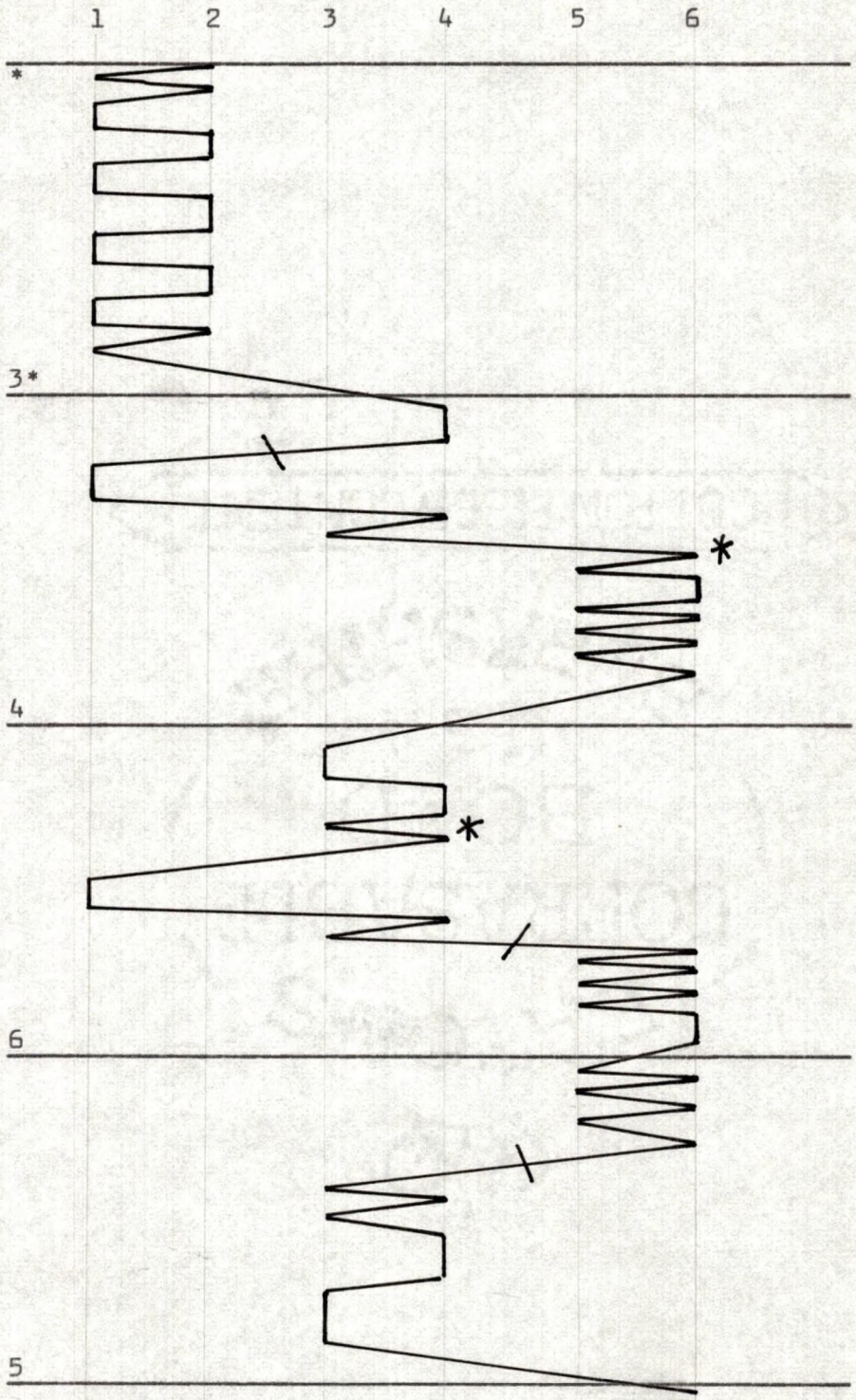
[9]"English Change Ringing," Chambers's Encyclopedia, 5th. ed., Vol. III.

DIAGRAM AND SKELETON COURSE OF THE SECOND BELL IN A "WOODBINE TREBLE BOB." TREBLE DODGES AT THE ASTERISKS AND THE STROKES INDICATE WHERE IT PASSES THROUGH.



CHAPTER V

THE TRADITIONAL CAST-BELL CARILLON

On the continent, the bell faced an entirely different destiny. The carillon was coming into its own, especially in the Low Countries. It is interesting to note that in Belgium, the country where carillons particularly flourish, the word "carillon" is hardly used. In Holland the usual name for the instrument is "klokkenspel," while in Belgium it is "beiaard." The carillonneur is known as "klokkenist" or "klokkenspeler," and "beiaardeer." The word "carillon" itself is adopted from the French and comes from the mediaeval Latin "quadrillionem," according to Grove's Dictionary of Music.[1] We can see then that the name of the carillon is traceable to the four diatonic bells that made up the tintinnabulum of the twelfth century.

More definitely, the instrument as we know it had its origin in a mechanical arrangement of sets of small bells in connection with the clocks which came to be an essential part of the municipal towers of the Low Countries in the fifteenth century. This mechanism, striking the small bells just before the hour, announced that the heavy hour bell was about to sound. It was not long before more than four bells were used, and as the number increased

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[1] "Carillon," Grove's Dictionary of Music and Musicians, 3rd. ed., Vol. I.

the mechanism was arranged to play a little tune. Soon there came the eight or ten bells of the Flemish "voorslag" or "forestroke," so called because of its play before the hour. To possess a "voorslag" was an indication of municipal progress, and the principal Flemish towns were soon well equipped. Owing to this periodic playing, which before long preceded the strokes of the half hour as well, bell music came to be a distinctive feature of life in the Low Countries.

As prosperity increased and as taste developed, still more satisfactory musical effects were sought. Bells were added to the "voorslag," all the intervals of the chromatic scale were supplied, and the barrel of the playing device was enlarged until each quarter hour had its share of notes and the hour tunes lasted a minute or more. This music was something that everyone could enjoy without stopping work.

The clavier (or manual keyboard) was coming into use with chromatic stringed instruments. Naturally this innovation became an integral part of the carillon. Later, to meet the requirements of the constantly greater number of bells--not to mention their greatly increased weight--a pedal keyboard was invented to supplement the manuals. William Gorham Rice has the following comments to make:

> It is not known when the great chromatic expansion occurred, nor can we tell where claviers, in connection with bells, first appeared. It seems to have been a gradual development, an outgrowth of the love of the **people** for a music which, as it decorated the passing of time, welcomed all, the high and the low, the artist and the artisan, the man in his shop, and the woman in her home, as participants in the pleasure it could give.[2]

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[1]Rice, p. 127.

Mention has been made of the development of the pedal clavier in conjunction with the increasing weight of the bells. This clavier was in use at Mechelen in 1583, according to Rice, and he feels that its invention took place earlier in the same period. The drum of the cylinder for automatic play was originally made of wood, but in the sixteenth century several examples of this device made of iron were in evidence. Jan Cal of Nymegen was the first to use copper in a drum, placed in the Nieuwe Kerk at Delft in 1664.[3] Since the adoption of the pedal clavier, the carillon has undergone change only in the improvement of the details of its mechanism, in the increase of the number of its bells, and in the accuracy of its tuning.

Before touching on some of the details relative to playing the carillon, I would like to quote a few lines of a letter received from M. Gaston Van den Bergh of Mechelen, Belgium. This very brief review of the history and evolution of bells and carillons came to me very early in our correspondence and provided the starting point for the thesis. The English is somewhat labored, but the details are clear and concise:

> Today I received your letter of October 28, and I am very glad you will write a thesis concerning the history of the bell and the evolution of the carillon, for I know, if I am well informated, NO carillons exist in North Dakota and the surrounding states.
>
> It seemes, the first bells were invented by the Chineze people, some thousands of years before J. Ch. - the first really brass bells were erected in Italy nearly among the year 800 after J. Chr. in the churchtowers.

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[3]William Gorham Rice, Beiaarden in de Nederlanden (Amsterdam: Van Klooster, 1927), p. 98.

> In 1370 one began to put big bells in the towers of bellfries (in the Flemish countries), to strike the hours, accompanied by 2 or 4 small bells, in order to inform : the hour bell will strike.
>
> This three or four small bells were extented to 5, 6, 7 or 8, and in 1510 the first hand keyboard was built in the Flemish city of OUDENAARDE. in 1556, the first foot (-or pedal) keyboard was erected in Mechelin, in order to play more heavy bells : the number of bells grew up from 9 to 18 and more bells : later on 35 (3 octaves) and afterwards to 47 (4 octaves).
>
> The 16th and 17th century, we had the "golden ages" of the famous Flemish and Dutch bellfounders : Melchior De Haze, Geert Van Wou, Francois and Pierre Hemony, the family Van den Gheyn, etc. . .
>
> During the 18th and 19th century, we had a decrease of the carillon art in our countries, but the Mechlin Mastercarillonneur Jef Denijn (born 1862; died 1941) was the grand promoter of the renovation. He changed the connections between the bells and the keyboard, and he made the latter more playable; the mediaeval "bell-playing" became at once a fine modern concert-instrument, on which all kinds of recitals could be interpretated.
>
> The carillon of Mechelen consists of 49 bells with a Bourdon of 9 tons. In the U.S.A. its all bigger : we know of carillons with 50, 60, and even more than 70 bells, with bourdons of 10 to 20 tons!
>
> That's in a few words the history of the bells and the evolution of the carillon.[4]

M. Van den bergh mentioned that during the eighteenth and nineteenth centuries there was a general decline in the popularity of the carillon. This is not surprising since carillons were often treated as spoils of war, and special havoc was wrought when the French invaders sacked the abbeys. Rice says that "Bells captured in a war were sometimes re-cast into cannon or carried away as trophies, or again they were sometimes ransomed as a town's most prized possession."[5]

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[4]Letter from M. Gaston Van den Bergh, Assistant Carillonneur of the City of Mechelen, Belgium, and Secretary of the Beiaardschool of that city, dated November 12, 1963.

[5]Rice, p. 127.

A word or two concerning the Hemony brothers would also be in order here. Their genius and skill made the name of Hemony particularly distinguished in their art. They were natives of Lorraine, but established themselves in the village of Zutfen. Both men were of limited education, but they were magnificent craftsmen, producing bells of great beauty of form and decoration. Above all, they possessed a great faculty for tuning bells. Smits van Waesberghe, contributing to the scanty literature of the subject, makes the following observation:

> Incidentally it may be of interest to recall that at this time Guarnerius and Stradivarius of violin fame, were active in Italy. But particularly is it of importance to notice the contemporaries of the Hemony's in the Netherlands. Such consideration will indicate that the carillon was the manifestation in music of the spirit of a race which at the same time was showing great genius in many other directions. Rembrandt, Vermeer, Rubens, van Dyck, Frans Hals, and Pieter de Hooch all lived at this period. Likewise Lieven de Key, the master builder, and Visscher, the famous engraver, and Vondel, the dramatist and poet. Tromp and de Ruyter were winning naval victories, and Grotius was writing his great works in international law.[6]

A large majority of the bells of Holland were manufactured by the brothers Hemony. In Belgium, most of the present bells of Mechlin and Antwerp were supplied by them, and they exported carillons to Stockholm, Hamburg, Mainz, and Darmstadt.

With this brief background we must turn to more detailed information concerning the carillon itself. While we have been referring almost constantly to William Gorham Rice, it is essential that we do so again since his definition of the traditional carillon is the most complete that can be found:

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[6]Joseph Smits van Waesberghe, Cymbala: Bells from the time of the middle ages . (Rome: American Institute of Musicology, 1952), p. 46.

> The musical instrument called the carillon (a) has as its basis several octaves of perfectly attuned bells (the ancient carillon had from two to four octaves while the modern carillon has from three to six octaves); (b) the bells tuned to the intervals of the chromatic scale (that is progressing by half tones); (c) each bell in the bass weighing often several tons, and the bells diminishing in size until, in the upper octave, each is fifteen pounds or less; (d) the bells hung in tiers, "fixed" (that is so as not to swing), in a frame (anciently of wood, now of steel); (e) the instrument placed high in a tower with ample openings for the unobstructed flow of sound; (f) the instrument played by a trained musician (called a carillonneur) seated at a keyboard (clavier, or console) and using hands and feet; (g) the manual having small slender levers (keys, spindles) of oak; (h) and for the heavier bells also oak pedals like those of an organ; (i) each key and pedal connected with its bell by rods and wires so that its spring balanced clapper strikes the sound bow of the bell on the inside; (j) music also being produced automatically (where desired) at striking of the hour and half-hour and quarters, by an electro-pneumatic or other mechanism operating a cylinder (drum, perforated roll) upon which tunes have been arranged; (k) this automatic mechanism by connecting rods and wires causing a spring balanced hammer (for quick repetition there may be several hammers for each bell) to strike the sound bow of the bell on the outside.[7]

The cast bell carillon is played in two very different ways, as indicated by Rice. The first is automatic and generally utilizes a large revolving drum. The use of this method would place the carillon in the category of a huge music box, the instrument then being called "Carillon à cylindre" or "Carillon à Tambour." Before the hour strikes, and at certain other intervals, this cylinder or drum is moved by a mechanism of its own which is released at the proper moment by a clock. On the hour, music is played for a minute or more; at the halves and quarters, for less time, and at the eighths, flourishes of just a few notes.

Pins or studs of iron are placed in holes on the surface of the cylinder arranged so that as the cylinder revolves they trip levers

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[7]Rice, pp. 199-200.

connected with hammers which strike the outside of the bell. Sometimes there are 10,000 or more holes suitable to receive the pins; say 100 rows, or measures of 100 holes each. With this large number of possibilities it is easy to see that almost any number of tunes can be played. In order to secure the quick repetition of a note, a single bell is sometimes equipped with as many as six hammers. The pins in the drum are slightly offset from their centers so that the bell may be sounded by the use of a properly selected pin at any one or all of several points in a measure.

Tunes are set on the cylinder by the carillonneur, and by periodic changing are made appropriate to any season of the year. Town tradition, in Belgium at any rate, sometimes handed down for a century or more, frequently fixes these tunes, but more often the musical taste of the carillonneur governs the selection.

Musically of far greater importance is the carillon that is played by a carillonneur, using a clavier somewhat resembling that of a piano or organ. The exact designation given the instrument in this circumstance is "Carillon à clavier."

Each key of the clavier is connected by lever and wire with the clapper of its corresponding bell. In what is known as the Belgian system, perfected by Jef Denijn, each clapper when at rest is held by a spring and guide wires in an exactly defined position close to the inner sound bow, and the bells are hung in parallel lines, the deeper ones enclosed in chambers within the tower.[8]

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[8] Jef Denijn, Beiaardklavieren (Mechelen: Beiaardschool, 1925), pp. 28-30.

Generally, in Holland the clappers have neither springs nor guide wires, which tends to make their mechanical operation much less accurate. The bells are often hung in circles or placed in the tower lanterns. This, however, while adding the element of the picturesque to the tower, prevents the most successful playing because the keyboard connections are necessarily less direct.

The bells of the lowest octave or two are connected with a pedal clavier. This is done for the reason that the larger bells require a more forceful stroke to bring out their full tone. The pedal clavier gives the carillonneur greater command of the resources of his instrument by allowing the use of both hands and feet, and enabling him to play music in three or more parts.

On the manual clavier great dexterity is essential, since much of the execution is with a kind of tremolando in which the keys are played from the wrist and the forearm. Scales and arpeggios are accomplished by the alternate use of hands. The greater part of the playing is on the smaller bells, with only occasional use of the larger ones. The reasons for this are that the small bells are more easily sounded, and that the effect of chords is much more satisfactory on them. On the large bells the harmonic tones are prominent and, when sounded together, frequently interfere with each other, causing the uninformed listener to remark that "the bells are out of tune." The harmonics of the smaller bells, on the other hand, are too high in the scale of sound to bother the listener. Chords are most satisfactory when played arpeggiando, and scale passages can be played with great speed and are most effective. When one is

playing in three or more parts, however, the greatest care is necessary as to the disposition of notes in a chord. The best effect is obtained when a wide interval is kept between the lowest note and the next one above it. All the degrees of crescendo and diminuendo are possible. The vibration of the bells does not continue for any great length of time, so damping devices are neither desirable nor necessary. When the smaller bells are played, the sound is dissipated so quickly that when the effect of a sustained chord is needed it is obtained by a rapid tremolando, similar to that used by the pianist.

Rice has quoted quite liberally from a work by a certain Mr. Rocke, who was the municipal carillonneur of Morristown, New Jersey, concerning carillon technique. Since this is the only mention of technique I have found in any of the works studied, I feel that it is important to include these paragraphs:

> The acquisition of technique in carillon playing is, perhaps one of the lesser difficulties that precede complete mastery of the instrument. For the actual physical elements are few. An experienced organist would find carillon playing a simple matter; a pianist would, of course, have to undertake the practice of the pedal board before he could perform accurately and rapidly with his feet.
>
> The side of the hand is used, the curved little finger engaging the lever. The stroke is a pressure stroke; the impulse coming from the upper arm muscles. However much it may appear to an observer that the performer is "striking" the levers, very little striking is done. Even in staccato scale and arpeggio playing the movement is rather a rapid, light pressure than a blow. In a tremolando (the principal means of sustaining legato melodies) the pressure is increased so as to keep the lever low during the rapid iteration of the note or notes.
>
> Advanced players acquire enormously strengthened fingers in playing two and three notes with one hand (in this case the hand is held out straight and the fingers stretched to reach the wide intervals) and players of the highest accomplishment can play a triad tremolando with one hand. The pedal playing differs from organ pedal playing in some respects. The heels are not used. There can be little crossing, although arpeggios

> can be quite easily played if the pedalling is carefully worked out from the first. The left foot will be used almost entirely for the lower half and the right foot for the upper half of the pedal levers but, in actual playing, it will be found that a good organ pedal technique is an aid to the carillonneur.
>
> If the latter is a practising organist he will be relieved to know that his carillon pedalling will not interfere with his organ pedalling in the slightest.
>
> When the few physical elements have become a part of the player's habits the further development of individual technique is solely a matter of psychology; the ear and the sense of touch guiding him entirely. The desired "pianissimo" prepares itself through the instantaneous response of the sense of muscle pressure--"touch" if you prefer the word. In this respect carillon playing offers practically all the fascinating problems in dynamics that the pianist enjoys. The carillonneur who thrills his audience with the multitude of gradations, singly and in combination, has passed through the same preparation that the pianist has.[9]

The biggest difficulty in carillon playing is the acquisition of the art of transcription. The most accomplished musician will find it necessary to listen to the bells, analyze thoroughly the works and transcriptions of Jef Denijn, Antoon Brees, or Kamiel Lefevere (when he can obtain them), and hear the works played by the men who have prepared them for the carillon.

M. Staf Nees, Director of the Beiaardschool at Mechelen, has made a comment concerning his art that should have a special impact on those who play the instrument. He says, "The carillon art is a very individual one. No two players handle the levers alike; obtain nuances and effects in just the same way; or transcribe and perform in an identical manner. In this factor lies inexhaustible possibilities for the enthusiast."[10]

The question is frequently asked, "What kind of music should

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[9]Rice, pp. 122-123.

[10]Prosper Verheyden, De Beiaard (Mechelen: Beiaardschool, 1926), p. 2.

be played on the carillon?" Rather than answer here, I would like to refer the reader to the appendix, where he will find reprinted a speech by the late Jef Denijn, presented to the First International Carillon Congress at Mechelen in 1922. I feel that no clearer explanation could be given regarding the material that should be heard from the bell tower.

CHAPTER VI

THE CARILLON IN THE TWENTIETH CENTURY

In this concluding chapter, it is unnecessary to be concerned about the shape of the bells, whether or not they hang in a tower and are suspended from a beam with or without their own crown, the impressiveness of their weight or dimensions, the action of transmission bars directing the action from the keyboard or clavier, or what the keyboard looks like. We are only concerned with the fact that the carillon, as we know it today, consists of a minimum of twenty-five chromatically-tuned bells which are playable from a standard keyboard.

In the twentieth century developmental work began for the technical and artistic improvements that would culminate in the ultimate perfection of the modern carillon. Mechanical and electrical inventions, new discoveries in metallurgy, and constant experimental work gradually lent impetus to the growth of the art of campanology, thereby improving playing facilities and clearing up many of the disadvantageous factors that were a part of bell ringing for centuries.

This research resulted in the development of carillons which are far superior in every respect to the finest campaniform bells ever built. These modern instruments provide nearly the same rich

tones of the finest of the traditional bells, but at a mere fraction of their cost. Tonally, each bell is held in close tolerance in tuning, and each individual bell is not only in tune with itself (as to the several partials in relationship to the fundamental), but is in tune with every other bell in the carillon.[1] This, of course, is not necessarily true of the cast-bell instrument.

With the development of the electronic carillon, installations both large and small sprang up in over 6,000 locations throughout the world: in churches, schools and universities, town halls, cemeteries, parks, music conservatories, historical shrines, and business establishments. It is not too surprising that the much-sought-after carillon became popular so rapidly, especially after the decline in bell-founding during the nineteenth century, since now it was no longer a necessity to have a massive tower structure to support the instrument. With the electronic bell, only a few ounces of metal are required to produce the tones of instruments weighing many tons. When struck by their small metal hammers, these tiny bronze bell-tone generators create sounds barely audible to the ear. Through specialized electrical amplification units the minute vibrations which produce these sounds are built up to equal or exceed the volumes of desired satisfactory bell tone.

We take it for granted that each bell in a carillon is accurately tuned and that all the bells are in perfect tune with each other. We recognize the fact that carillons may vary in size

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[1] John Klein, The Art of Playing the Modern Carillon (Glen Rock, N. J.: J. Fischer & Bro., 1961), p. 16.

from a minimum of twenty-five bells to an existing one of nearly fifteen hundred bells. The instrument may have one keyboard or more, three or more expression pedals, and a full pedal clavier. The more bells in a carillon, the greater the variety of timbres available to the carillonneur; consequently, our modern multiple carillon has become a musical instrument of perfection.

Mention was made of a carillon of nearly fifteen hundred bells. This is the largest electronic instrument of its kind in existence, and is located in the carillon studio of the Schulmerich factory. The carillon itself is what is now known as stereophonic--that is, it is constructed with dual sets of bells, allowing the performance to emanate from two distinct locations. The two manual keyboards each contain the following sets of chromatically-tuned bells:

61 Flemish Bells of eight-foot pitch
61 Harp Bells of eight-foot pitch
61 Celesta Bells of eight-foot pitch
61 Minor Tierce Bells of eight-foot pitch
61 Quadra Bells of eight-foot pitch
25 English Bells
25 Chimes
25 Celestial Harp Bells
49 Flemish Bells of four-foot pitch
49 Harp Bells of four-foot pitch
49 Celesta Bells of four-foot pitch
49 Minor Tierce Bells of four-foot pitch
49 Quadra Bells of four-foot pitch

In addition to the manual keyboards, there is also a full pedal clavier containing the following bells:

32 Flemish Bells of eight-foot pitch
32 Harp Bells of eight-foot pitch
32 Celesta Bells of eight-foot pitch
32 Minor Tierce Bells of eight-foot pitch
32 Quadra Bells of eight-foot pitch
25 English Bells
25 Chimes
25 Celestial Harp Bells

These various sets of bells are drawn into play by the use of traditional organ-stop tablets. Four expression pedals control the dynamic levels, and a variable electronic tremolando control permits the performer to trill on single notes, octaves, or even chords.[2]

The multiple bell carillon provides these dual sets of bells to allow unlimited exploration and experimentation in the art of carillon playing. Whichever style or technique of playing the student wishes to master, the traditional or the contemporary, one thing is essential: he must acquire through study and practice the fundamental knowledge of the principal rules governing the combining of two or more bells to produce music. He must realize that man receives little help from nature anywhere in the design of a carillon. Nature does not control the ratio of harmonics in a bell as she does in the string, the pipe, the reed, and the human voice--all of which are natural objects. The bell is man-made, and is therefore an unnatural object. Man had first to discover the proportions which would assure the bell a pleasing series of overtones, and then he had to tune these overtones into the bell--as we discovered

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[2]Klein, p. 22.

in a previous chapter.

There are two aspects to this matter of proportion. "Collective proportion" refers to an entire series of bells. The other category is "individual proportion," or the proportion of the different sections of a single bell. This was discussed in some detail in Chapter II; however, some information was withheld deliberately so that it could be brought in at this point, in specific relationship to the modern carillon. One of the leading producers of the electronic carillon has published the following facts regarding proportion and tone:

> If a bell has a certain note--and is tuned perfectly--it will produce a series of overtones which we have come to know as the correct ones for the carillon bell. There will be the Strike Tone, the Hum Tone, an octave below the Strike, the Prime Tone, on a unison with the Strike, the Minor Third and Fifth above the Strike, the Octave above the Strike, the Major Third and Fifth above the Octave, the Double Octave of the Strike, the Fourth and Sixth above the Double Octave, and then the Third Octave above the Strike.
>
> When the Flemish Bell is struck, the Strike Tone comes out with brilliance and clarity. The Minor Third is there in surprising strength. The Octave will be heard for a short time. The Prime Tone will carry on long after the Strike Tone has lost its brilliance--in fact, it will be thought that the Prime Tone is the continuation of the Strike. When the bell is perfectly tuned and the Prime and Strike Tones are identical in pitch, the Prime will cover the Strike so perfectly that the Strike will appear to dissolve itself into the prime. When the Strike Tone loses its force--which it does almost immediately--the Prime must be there to carry on the pitch impression of the bell, with some help from the Octave and the Hum. The Hum Tone will continue long after the other tones have ended their sound, but an octave lower of course. This note has been vibrating in strength since the bell was struck, lending its quality to the general tone picture.
>
> It should be unnecessary to point out that if any of these tones were as much as a few vibrations out of place, causing their partials to disagree with each other, the bell would be false. It is true that some deviation of pitch in the several harmonics would not necessarily harm the tone of a single bell, but, if that bell is to represent a note of

> definite pitch and quality in a carillon, and if it must blend with other bells, its deficiencies would soon be noted.[3]

Each of the bell's partials plays not only the role of pitch, but also of intensity. The Strike Tone of one bell may be more brilliant, or vibrate longer, than that of another. In some bells it is particularly noticeable that the Minor Thirds assume great importance--in fact, they are so strong that there is considerable clash when a Major Third is played upon the carillon. This is frequently remarked upon by musicians and laymen alike, uninitiated to the peculiarities of the instrument. It is this Minor Third, of course, which is always at the bottom of the expression, "it sounds out of tune." Some bells have particularly strong Strike Tones, while other bells are weak in this respect. All these differences are due to the relative strengths of the several partials within the bell. These different intensities are directly due to different proportions.

There are some partials in a bell whose strength should be increased, and there are some whose strength should be diminished. Some foundries have been able, by their studies of proportion, to diminish the strength of their Minor Thirds, and have also succeeded in augmenting the strength of their Primes. The advantages of weaker Minor Thirds are quite apparent. With stronger Primes, the bell does not lose its note soon after being struck, but continues to sing and assert itself for a longer period. The Mears Foundry of Whitechapel, England, noting the troublesome effect of a Dominant Fourth just

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[3]Robert Carwithen and John Klein, The Carillon (Sellersville, Pa.: Schulmerich Carillons, Inc., 1961), pp. 8-10.

above the Strike Tone in bells below Middle C, weighing about 5,500 pounds, has successfully overcome the origin of this undesirable tone, although just how this was done is carefully guarded as a trade secret.[4] All this improvement, however, has come about through the intensive study of proportion--that is, the proportion of individual bells.

Through research on carillons in both the Old World and the New, it is comparatively easy to recognize those instruments which remain the same, from decade to decade, true to a prototype that was established when each company produced its first "perfect" carillon. Bigelow is very positive in his statement that "There are some companies which have done absolutely no research in the several years during which they have been producing carillons. The result is that their instruments are today exactly as they were twenty or thirty years ago."[5] This statement pertains particularly to those manufacturers who still persist in trying to obtain good bell tone through the use of a vacuum tube. They have arrived at what seems to them to be the ultimate, and have undertaken no further studies. On the other hand, there are companies which have changed the proportions of their bells (both cast-bell and electronic) with a view toward producing an instrument with a more pleasing tone and a better balance throughout its registers. It is not difficult to see that in those instances where the manufacturers have accomplished the object of their research, they have made a better carillon both musically and acoustically.

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[4]Rice, p. 225.

[5]Bigelow, p. 89.

As a case in point, Schulmerich Carillons, Inc., have produced a multiple carillon of great beauty of tone--the result of their constant effort to improve their product. The Flemish Bells, comprising the full range of 61 notes, are the heart of the carillon. From the great Bourdon Bell, the equivalent of twenty-two tons of bell metal, to the twenty-six pound "C" five octaves higher, the range is rich and brilliant. Unlike the English Bells, all harmonic combinations are possible on the Flemish Bells. There are no restrictions. Major, minor, augmented and diminished chords, or any other type of harmony for that matter--arpeggios, trills, or tremolandos--can all be executed with comparatively little effort according to the ability of the carillonneur.

The Harp Bells are the antithesis of the great Flemish Bells. Their timbre is soft and velvety, a characteristic quality independent of pitch and loudness. These graceful bells have a definite depth and solidity of tone and, unlike the English or Flemish Bells, have octave tuning in their partial series. Striking Middle "C" on a Harp Bell, its partials would be "C" an octave lower than the Strike Tone, "C" above Middle "C," and the second "C" above Middle "C." The principal function of the Harp Bells is to provide an accompaniment to the larger solo bells of either the English or Flemish tuning. With the addition of the tone-color of the Harp Bells (on a separate keyboard), complete compositions can be played in their original form. The effect of the Harp Bells when heard from the tower is decidedly ethereal. Their use as a separate and individual set of bells is very desirable. Often, on a multiple carillon consisting of only the minimum twenty-five-note range of the Flemish and Harp

Bells, an entire number can be played on the Harp Bells, offering variety in the program. On the other hand, short passages can be played on the Harp Bells alone before returning to the combination of Flemish and Harp, again providing relief and variety within a single composition.

As a general rule, the Celesta Bells should be the third set added to the carillon. The timbre of these bells is keen and brilliant, and they express a delicate brightness. Their usefulness either alone or in conjunction with the Harp Bells is invaluable. Like the Harp Bells, the Celesta Bells have selected octave tuning in their partial series. When added to the carillon they assume an unusual importance in their function as another tone color. At first they would seem to have three main uses:

1. For use in solo or chordal passages,
2. As an accompanimental set of bells,
3. For use in conjunction with the Harp Bells.

Through the manipulation of a stop tablet, the Celesta Bells can be skilfully used for brief interruptions during a Harp Bell passage. They can be brought on or taken off instantaneously for even the punctuation of a note or two. They are more sprightly than the Harp Bells and can therefore be played in a faster tempo. For tower playing, when the Celesta Bells are added to the Harp Bells, there is a certain "edge" or "bite" in the tone that enables these smaller bells to cut through to a greater advantage.

The timbre of the Quadra Bells is more precise than that of either the Harp or Celesta Bells. Like the Harp Bells, however, the Quadra Bells have a very definite depth and solidity of tone, are

more piquant, and have a more comprehensive quality. The three primary functions of the Quadra Bells are color, reinforcement, and mixing. For variety in color, they can be used either as solo bells or played in chordal passages. As a reinforcement to the Harp Bells, they provide a preciseness to the tone, especially for outside or tower playing. The mixing of the Quadra Bells with other tone sources furnishes unlimited tonal varieties--for instance, the mixing of the eight-foot Quadra Bells with the four-foot Minor Tierce Bells, or of the four-foot Quadra with the eight-foot Harp.

The Minor Tierce Bells are the last to be discussed here. The chromatic range is the same as that of the other four sets of bells, or five complete octaves. These bells are quite different in timbre from all the others. The Minor Third is unobtrusive, yet, with its fundamental, there is a haze around the tone. These bells can function directly or indirectly--that is, alone or in the company of other sounds. When mixed with another tonal source, they produce a lustre and add a certain gloss to the tone. Their decay is delicate and brief. In the middle and upper registers these Minor Tierce Bells sound "like a polished twinkle," according to Mr. John Klein, official carillonneur of the Schulmerich organization. In the low register, he says, "they create a mysterious and feathery strum."[6]

The complete comparison of the partial series of the five sets of bells may be seen in the illustration on the following page.

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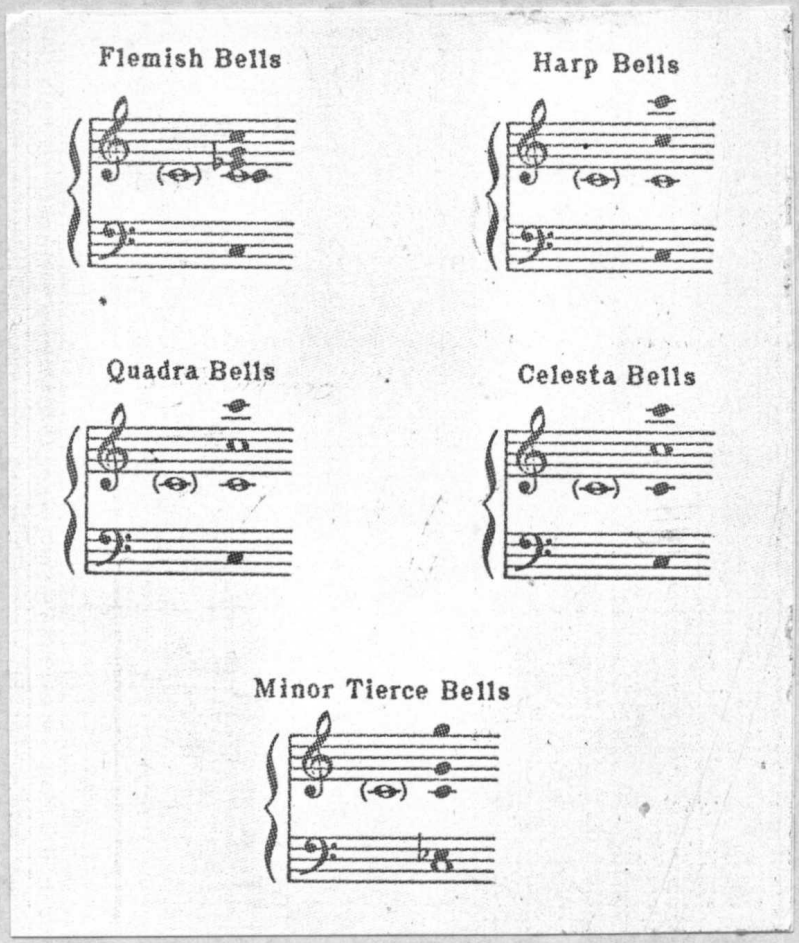
[6]Klein, p. 21.

PARTIAL SERIES OF VARIOUS SETS OF BELLS
Schulmerich "Carillon Americana"



To all outward appearances the console of the modern carillon is identical with that of the organ. The similarity ends there. As opposed to the carillonneur of traditional training, the modern player has virtually no control over the touch on the multiple instrument. The player can make no distinction whatsoever between legato or staccato. The bell is struck, and its two qualities of tone, the ring of the bell and its natural decay, evolve and transpire. Since the carillon is purely a percussive instrument, the carillonneur cannot even connect his tones as on the percussive piano, because he does not have the same type of control he would have on that instrument. When metal strikes metal, the point of

contact is the same whether the key is struck with precision and strength, or gently caressed. Changes of tempi, dynamics, and expression are all possible on the modern carillon, but accents, sforzandos, and dynamic phrasing must all be simulated with a time element. The hesitant pause just before a so-called accent will give the illusion of the next bell or bells sounding louder; and likewise, the spacing of notes within a melodic line will give the effect of dynamic phrasing.

Concerning the use of the expression pedals, it should be stressed that the carillonneur must be overly cautious in their use. The worst offense is to pump the pedals. This only results in complete frustration and annoyance for the listener. Mr. Klein is very concerned over this aspect of the modern instrument:

> Let us take one situation. The listener is at a moderate distance from the source of the tone of the bells. He is neither too close nor too far away. The carillon has been playing at a certain dynamic level to the complete enjoyment of the listener. Suddenly the sound disappears. For a short period of time the listener cannot hear the bells: then suddenly they crescendo to a hearing level again. If this happens frequently within a number, the listener will lose interest to the point of being annoyed.
>
> Why did this happen? Obviously, from reasonable logic, it was because the carillonneur thoughtlessly decreased his expression pedals to the level of forcing the sound to disappear. What the carillonneur hears through his monitor, usually under an ideal quiet atmosphere, is not being heard outside under the same conditions.[7]

We must remember that as one of the supreme musical voices throughout the centuries, the carillon has always remained the beloved voice of the people in both Europe and the New World. Its ownership has not changed, for the music of the carillon belongs

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[7]Klein, p. 22.

to everyone. It sings in a language known and loved by people everywhere. We have referred in the previous chapter to a speech given by M. Jef Denijn, probably the world's most famous cast-bell carillonneur, concerning the material that should be heard on the bells. Naturally, situations have changed, and the music that is adaptable to the multiple carillon of this century is certainly not as limited as that to which M. Denijn had access.

Klein, as the foremost carillonneur of the multiple instrument, has this to say regarding repertoire:

> The repertoire is unlimited. The list may include hymn-tunes, so called sacred compositions such as songs and choral works, folk songs of many nations, ballads, patriotic pieces, the classics, airs from operas, songs from operettas, popular tunes, original compositions, etc. This is indeed an imposing catalogue.
>
> The carillonneur, however, begins by being sensible in programming appropriate material. First of all, he should plan on playing only the music which he is technically equipped to play; the music should be suitable to the location of the carillon; he should take into consideration the season of the year and the days of celebration; and, above all, he should program music that is generally familiar to the people.
>
> He must realize that, as an ultimate end, the music of the carillon is not, usually, part of an educational project; that he is not performing solely for a group of carillonneurs who might be admiring his technical skill; and he must recognize that titles and composer's names that look impressive on paper do not necessarily make good music for listening.
>
> The carillonneur must be consciously aware of the fact that when the carillon's bells begin to sound from the tower, the music is, in most cases, being imposed on the people. Perhaps they have come to hear the carillon of their own free will, but in a sense, they are not invited guests; they are not a paid-admission audience.[8]

Obviously, such a location as the famous Bok Singing Tower at Lake Wales, Florida, is an ideal setting for carillon music. Most carillons, however, are not so generally favored. Therefore, it is

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[8]Klein, p. 24.

better to consider the average location and the average audience.

Isolated compositions from the pens of composers of all periods can be found to be good material; and, needless to say, when these pieces are discovered they should be placed in the carillonneur's repertoire. The mere fact that the music was written by Bach, Beethoven, Byrd or Brahms does not necessarily mean that it is good or worthy of performance on the carillon. All music should be selected because of its suitability for the instrument and for its general attractiveness to the listening audience. These are really the only rules to observe in making up a program.

A certain amount of original carillon music is published in Belgium and in this country. This music was specifically written for the carillon by carillonneurs who, in most cases, were not and are not always musical. Consequently, the value of much of this material is questionable. If any of this music is performed, we might say that we do so out of a sense of duty, or perhaps in respect, or possibly as an educational venture. Unfortunately, the musical vehicle of the carillon never attracted the Mozarts, the Beethovens, the Schumanns, or the Mendelssohns to write for the instrument. With the advent of the modern multiple carillon, however, more and more fine composers--notably, Samuel Barber, Gian-Carlo Menotti, Alan Hovhaness, and Daniel Pinkham--are discovering the limitless possibilities and avenues of expressing themselves through this medium.

Unfortunately, many of those artists who are excellent performers on the traditional instrument regard the electronic

carillon as something of a poor "step-child." Arthur Bigelow of Princeton University is not quite as bitter as most of his colleagues in his feeling towards the instrument. He is even willing to admit that the electronic carillon has an important role in our modern way of life:

> Not long after the organ was imitated through electronics with radio tubes and amplifiers, the same ingenuity was applied to the carillon. Here, at last, was a means of fulfilling the need for a low-cost substitute for bells. Since the vibrating bodies are little more than a set of small bars, coils, or springs, taking up less room than a flower box, it is not even necessary to have a tower for an electronic carillon. A place to put the loudspeaker is enough and the task of playing is accomplished simply on a standard piano keyboard. The effect is sometimes disconcerting. From a small turret, measuring only five feet in diameter and not large enough to house the smallest bell of the Big Ben chime, the great Westminster quarters may be heard as well as a sonorous carillon selection.
>
> With this new turn, the carillon joined the ersatz trend of the twentieth century.
>
> Despite the advantages of the electronic system, it is regrettable to find a great tower, beautifully constructed and strong enough to hold the tons of metal for which it was undoubtedly designed, which shelters nothing more than a brace of loudspeakers. It is regrettable, but the fact must be faced that sufficient funds are not always on hand to equip a tower appropriately. When a substitute instrument is worthy of the carillon name, it brings the charm of good bell music to localities which might otherwise be denied it.
>
> Yet, just as the radio is unquestionably bringing some good music into homes where otherwise music might rarely be heard, the electronic carillons are bringing the sound of good bells into areas where they had never been heard before. In this the electronic carillon performs a needed service and its part in the development of the interest in bells in this country must not be underestimated.[9]

We must note here that there are really few differences between performing on the two types of carillons. The traditional instrument is, of course, much more demanding physically; however, in the writer's opinion, performance on the modern multiple instrument

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[9]Bigelow, p. 127.

is far more rewarding aesthetically, and far less limited in regard to repertoire. Percival Price was certainly correct in his assumption that we cannot tell what the future will bring, or what will emerge from the "singing towers" of later years.[10] Even as he predicted in 1933, electrical devices have in some instances replaced the carillonneur, to the detriment of the instrument. It is certainly to be hoped that a renaissance will take place once again, this time exploiting the modern electronic instruments to their fullest extent.

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[10] Price, p. 28.

On Thursday Evening, June 25, 1964, a Lecture-Recital based on the contents of the thesis was presented by the writer in the Carillon Room of Twamley Hall on the campus of the University of North Dakota. The program of this Lecture-Recital will be found on page 74 of this volume. For the convenience of any person who may be interested in hearing the program, a tape recording is on file in the library of the Music Department.

The University of North Dakota

Department of Music

LECTURE-RECITAL

by

Paul E. Lundquist, *Carillonneur*

(B. Mus., 1950, MacPhail College of Music)

Carillon Room (409), Twamley Hall

Thursday, June 25, 1964

7:30 p.m.

THE PROGRAM

Excerpts from a thesis written by the candidate on
"The History and Evolution of Bells and Carillons"

PART I

A. "A Short History of Bells"
B. "Bell Founding and Tuning"
C. "Bells of Historical Interest"
D. "Comments on English Change Ringing"
E. "The Traditional Carillon"
F. "The Modern Multiple Carillon"

During the brief five-minute intermission following the lecture, the audience is requested to go from the Carillon Room and re-assemble outside on the mall for a fifteen-minute recital. This move will enable the listener to hear the bells in the proper setting. In the event of inclement weather the recital will be played using the speakers that are located in the console.

PART II

Twenty changes on seven bells	"Grandsire Triples"
LUNDQUIST	U.N.D. Alma Mater
JEF DENYN	Andante Cantabile
KAMIEL LEFEVERE	Allegro and Menuet
GASTON VAN DEN BERGH	Inleiding, Lied en Variaties op "Het Vendel moet marscheeren"
ALAN HOVHANESS	Gamelan and Jhala
DANIEL PINKHAM	A Song for the Bells
JOHN KLEIN	In Mirabell Garden
Twenty-five changes on four bells	"Plain Bob"

Presented in partial fulfillment of the requirements for the degree of Master of Arts

APPENDIX II

WHAT SHOULD THE CARILLON PLAY?

Translated from an address delivered at the Congress of Carillon Art at Mechlin, Belgium, 1922,* by the City Carillonneur of Mechlin and Director of De Beiaardschool te Mechelen, the late

Jef Denyn

The Jury of the carillon competition held at Mechlin in 1910, in its report on the pieces chosen and played, expressed regret that so little use was made of our rich treasury of Flemish folk song, both old and modern. I have carefully followed the playing of our bell-players and the arrangement of their recital programmes, and have very seldom found that the advice of this committee has been followed, and even that it has been wrongly applied. That is one of the reasons why I wish to speak to you about the right selection of pieces in the repertory of bell music.

In Peter Benoit's Rubens-cantate, the title of which is Vlaanderens Kunstroem (The Glory of the Art of Flanders) the poet, dreaming of the mission assigned to the art of his honoured country, hears the question rise: "And then--and then?" And men, women and children answer, "Then the carillon will play from every tower!" We all wish that the carillon, expressing the finest sentiments of our people, will never give forth anything but beauty in its clearest interpretation; and this is why I examine with you today: what should the carillon play?

Music written expressly for bells, in good form in both old and modern styles, should have first place in what is played on the carillon. In providing this, although the sources are not rich, but nevertheless important, we can mention:

Eleven Preludes, including the famous 'Cuckoo-Prelude," by Matthias van den Gheyn, the famous Louvain carillonneur of the 18th century;

A Fugue written for carillon by Julius Vandeplas, formerly carillonneur of the St. Gertrude Church, now teacher at the Conservatory of Louvain.

A Sonata by the late Gustaaf Van Hoey, onetime director of our Music Academy and from his youth a lover of the carillon. This was specially composed as the test piece for the competition at Mechlin in 1897 -- the first held not to select a carillonneur for a post, but rather for furthering the artistic development of carillon music;

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* Published as "Wat zal de Beiaard spelen?" in the Handelingen van het Eerste Congress voor Beiaardkunst, Mechlin, 1922.

An Introduction, Air and Variations, also an Allegro Commodo by the English campanologist William Wooding Starmer, member of the jury of the carillon competition held at Mechlin in 1910;

A Gavotte for carillon by the English musician C.E. Miller;

An Allegro Rondo, a splendid exercise for carillon by K.F. (J.A.F.?) Wagenaar, bell-player at the Cathedral of Utrecht;

A Fantasia written for the "Netherlands Carillon Book" in 1916 by Emiel Wambach;

An Andante Cantabile which I wrote to serve as test piece for the honours prize in the carillon competition held here in 1910;

To show the possibilities of technique and variety in carillon music, I have written down a few preludes such as the Prelude in G Minor (1897) and Prelude in B Flat (1904);

In an Ave Maria I wanted to produce a carillon piece useful for religious festivals;

Further, we have a Lento by Kamiel Lefevere, and also a Voorspel in D Minor and a Thema met Variatiën by Gustaaf Nees, both assistant carillonneurs at Mechlin.

The pieces shown in our Exhibition of Carillon Art are almost all good exercises in which the exacting and tasteful shading make repeated demands and test the technique of carillon playing. One will also find in the Exhibition, carillon music with which I have become acquainted there, namely that of Boudewijn Schepers, carillonneur and organist of Alost in the 18th century, and of Karel De Mette, the present carillonneur there, as well as a whole series of carillon compositions recently written by Dutch composers. Experience will teach us which of these are suitable for carillon.

Now we come to classical music, so various in melody and thematic development. Although it may be good for carillon, it is mostly written for harpsichord and edited for piano. How seldom it is used by our carillonneurs! I mention, for instance, two groups of six sonatinas by Ignace Pleyel, a group of six sonatas by D. Steibelt as well as his splendid Sonata in C (allegro resoluto, andante, rondo turc) which is known everywhere and is very suitable for the carillon keyboard, also two groups of Sonatas by Valentin Nicolai in which the allegro rondos of the 1st and 4th Sonatas, and the 3rd and magnificent 6th Sonatas, are especially remarkable. Furthermore, I find magnificent music

by Richter, Reichler, Koseluch, Fiocco and Fr. Krafft. Krafft, who was choirmaster of St. Bavon's in Ghent and member of the jury for the carillon competition held at Mechlin in 1772, wrote a lovely divertimento polonese (in 1° and 2° tempo) for harpsichord which is good on the carillon.

Thanks to Mr. René De Bock of Antwerp, our exhibition is enriched by a precious book, written in 1746 by Joannes de Gruytters, "carillonneur or bell-player of the city and cathedral of Antwerp" in that year. This unique manuscript (unlike the chimes books kept in different cities and which, simply containing airs and arrangements to be played by the chiming mechanism, have less justly been called carillon books) contains not less than 194 pieces arranged for carillon in the style of his time.

The repertory of Joannes de Gruytters contains two gigues by Arcangelo Corelli, an andante by Locatelli, two adagios and an allegro by Vivaldi, a courante by Lully, three gigues and other pieces from suites by Fr. Couperin, a gavotte by G.F. Handel, a march by Richter and a significant collection of instrumental pieces by his countrymen, principally by Antwerp composers of the first half of the 18th century, among whom Hendrik-Jacob de Croes comes first with 17 minuets and parts of sonatas, followed by Jan-Thomas Baustetter, Willem de Fesch, Josef-Hector Fiocco and Deodaat Raick. It contains a march by the Mechlin city carillonneur and organist Jan Colfs, a splendid allegro by a Scheppers -- either Boudewijn Schepers of Alost or his brother Peeter, the Ghent colleague of de Gruytters -- and a minuet, an andante and a Cecilliana by the Antwerp carillonneur himself. To a great number of pieces in the same style, no author's name is given. Very few songs are included: Cruys Capelleken, Den brusschen (Brugschen?) Omeganck of de drij Sotten, Soet Chatarintjen, De Mey and Maria Schoon, also a contredanse Mamatje Lief, a Weversmarsch and Het Carillon van Duynkerke. This certainly is a remarkable carillon repertory! Roughly half of it is minuets (81); the number of marches is 31.

Many questions arise in the consideration of this music; questions relating both to the possibilities of the instrument and the technique of the player. I shall try to answer these in a moment. In the meantime, a couple of observations: in the melodies of all the pieces there is no grouping of notes for the same hand, so that in no wise a polyphonic* arrangement was intended, such as the full arrangement of modern playing.

Our predecessors were very adept in the use of counterpoint, for, if in all these pieces they played as Joannes de Gruytters has transcribed -- as for example the Allegro no. 184 and the Allegro of Vivaldi (no.187) -- then it is clear that they were masters of this part of the playing technique where unfailing beat and marked rhythm were demanded. This would not have been

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* Does he not mean fully harmonic? -- Translator.

possible without giving the minutest care to the instrument. It was a great pleasure to me to state that the carillon repertory of Joannes de Gruytters will be very useful to us for the first year of instruction at the Beiaardschool. In fact our carillonneurs, before going to the interpretation of songs, wherein they have to have skill in harmonising, shading and performance, might first master a strong accent, unvaried tempo and clear rhythm on the keyboard.

We can believe that the colleagues of Joannes de Gruytters also made use of the harpsichord music of their country and times. In our exhibition are publications of J. Boutmy, Fr. Krafft, D. Raick, J.-J. Robson and F.-J. de Trazegnies; these works appear in lists of subscribers wherein are mentioned, apart from persons of the nobility and upper bourgeoisie, a few musicians including organists and also carillonneurs.

Our Flemish and Dutch songs, in suitable arrangements, generally yield an inexhaustible treasure for the carillon repertory. Time does not let me give even the smallest list of modern songs, daily increasing in number, which come to our attention. It needs no explanation that, for the carillon, a simple arrangement is preferable for both old and new folk songs, including children's songs and lullabies. I don't have to give you any titles from this repertory! One can find pieces which suit the carillon in the lists of works of our composers. In the first place come the sweet melodies and characteristic piano pieces of our great master Peter Benoit, also songs by Jef van Hoof, Paul Lebrun, Jan Blockx, K. Mestdagh, Aug. De Boeck, L. Mortelmens, E. Wambach, Brandts-Buys, Richard Hol and Viotta.

I must, however, point out right away a requirement in the carillonneur's selection which must be kept in mind.

Let me take Peter Benoit's Mijn Moederspraak as an example. This magnificent art song may be given on the carillon only with a suitable accompaniment, and in order to make it of artistic worth we must maintain the interpretation of the irreproachable smoothness, rhythm and phrasing of the melody. I insist on beat and rhythm, which ordinarily is not followed closely enough in carillon playing. The carillonneur is allowed many modifications that would not be tolerated in piano or orchestral performance. He will perhaps tend to simplify the accompaniment and to make certain tonal alterations according to the construction of the carillon and keyboard; but all this must in no way alter the character and spirit of the composer's work. The double demand put upon the carillonneur in the execution of such a work shows how careful he must be in the choice of his pieces; his artistic conscience must always speak stronger than the consciousness of his virtuosity.

Just because a piece conforms to popular taste and is really beautiful, is no reason for wanting to play it on bells. Example: Ik ken een lied by Willem Demol. The carillon is not able to interpret the complete artistry to which this fine piece is entitled. In the first place it contains two different melodies, like man and woman each independent and yet inseparable from each other. The melody in the accompaniment is continuous, the vocal line is broken every two measures. Here no suitable arrangement is possible. Melody and accompaniment must both be given whole. Here lies the main problem, for if the presentation is to be successful there must be differences of "timbre": human voice for the song, piano or 'cello for the accompaniment. This contrast makes the song live. Because the carillon can only use bells, melody and counter-melody cannot avoid becoming disastrously melted together, so that in spite of all attempts, the results are very poor in comparison with the deep impression unfailingly made by a good arrangement of a piece for voice and instrument. Therefore, out of respect for the good qualities of the beautiful work by Willem Demol, the carillon should not play it. I could give you a number of other similar examples.

Let us consider old songs. There is a considerable collection for our use: Het oude Nederlandsche lied by Fl. Van Duyse, Het liederboek van Groot-Nederland collection by Fr. Coers, the folksong collections by Daniel De Lange, van Riemsdyck, Dr. Kalff and A. Loosjes. For old religious melodies, Christmas airs and folksongs, I also refer to Jan Bols.

From these collections I have arranged about fifty old songs for modern carillon playing. The collection is in our exhibition. There you may see: Lacht, zoet geslacht, Mijn hertken heeft altijd verlangen, Daer stået een clooster in Oostenryck, Van drie ghespeelkens, Dans der Maagden, Een seraphijnsche tonghe, Halewijn, Heer Daneelken, Het Heerke van Maldegem, also characteristic songs such as: De Scheerslicp, De Herberg, Inleidingslied op't Zingen, Het lied van de H. Barbara, etc. Well, I never see any of these on the programmes of our carillonneurs. And they are nevertheless very beautiful melodies which can be played on the carillon without fear of mutilation.

Among old French songs the Weckerlin collection gives us many beautiful shepherd songs or bergerettes which can also produce a wonderful effect on the carillon, for so many of the melodies are harmonised with chords in the minor mode and with similar bass accompaniment. They include: Que ne suis-je la fougère, O ma tendre musette, Rose inhumaine by Campra, Mon coeur se recommande a vous. The collection of Christmas songs by Leon Roques, organist of St. Pierre de Chaillat, which includes Il est né, le divin Enfant, Parissez, aimable monarque, Dans cette étable, O Dieu, l'étrange chose, is also useful.

The 19th century masters of song have given the carillonneur a wide range to select from, including pieces which are artistic and have well presented ideas, and among which can be found requirements for special occasions such as that to which I have just referred. Examples are Grieg's Solvejgslied, Chopin's Marche funèbre, Mendelssohn's Barcarolle and songs (without words) such as La première violette, Est il vrai?, Confidence des fleurs, Schumann's Traümerei, Frühlingsgruss, Hinaus ins Freie, Schubert's Rosamunde, Lob der Thränen, Frühlingsglaube, Ständschen, (Serenade), Ave Maria, and also countless folksongs of French, English, German and Russian origen.

An old custom, still honoured at Mechlin, is the announcement of church ceremonies by the carillon on great festival days. On Easter Day I play the Christus vincit on the carillon, on Whitsunday the Veni Creator, at the Feast of the Holy Sacrament the Adoro te, on the Day of St. Rombold, the patron saint of Mechlin, the O Amator castitatis, on Assumption Day the Magnificat and Ave Maria, on All Saints' Day the Litany of the day, and on Christmas Day Adeste fideles and all sorts of old Flemish Christmas songs, as well as English, etc.

You see really how much our carillonneurs have to draw upon to fill out their repertories. It is therefore superfluous to take, for bells, music in which the interpretation cannot help but be imperfect. We name among others as example, the Adagio cantabile of the Sonata pathétique of Beethoven. I have seen the piece more than once on programmes of carillon recitals. In the work of the greatest master it is not satisfying simply to execute a beautiful melody when one thereby diminishes the whole character of the piece. Actually, the eight-measure melody re-occurs five times, each time ornamented with different variations in the accompaniment; these come out on the piano but are impossible on the carillon keyboard, and therefore the one who ventures to try it is simply left in the lurch. It is enough to say that the limited pedal register is insufficient for giving the necessary bass notes which are so beautiful in the original. Thus it is clear that no satisfactory arrangement is achievable, so it rests with the sound judgment of the carillonneur who has respect for the magnificent creation of Beethoven, to leave it for the pianist.

For the same reason, fragments of operas are disapproved of for carillon presentation. Let me, for example, point out Wagner's Tannhäuser; what is chosen from it is too heavy for carillon playing. Thus Wolfram's "Song to the evening star", besides wandering through a series of modulations, is somewhat less clear in an exact arrangement on any carillon, and requires great muscular energy to bring it out. In general, one stays away from modern operatic excerpts, not only because bells present this theatre music falsely, but also because of the forced modulations.

There are, nevertheless, some exceptions for certain song-like lyric or brilliant arias from operas by Donizetti, Bellini and Verdi. The cavatinas from Rossini's Barbiere and La Gazza ladra give an outstanding opportunity for showing the carillonneur's virtuosity and technique in sound. The tenor aria from the 2nd Act of Bizet's Les Pêcheurs de Perles can be successfully interpreted on the carillon.

Those who take an historical viewpoint and regard the carillon as an archaeological instrument, will not agree with me over these concessions, even with all the restrictions I have made; perhaps they will even entertain strong disapproval of my ideas. I know very well what makes them so prejudiced: they think of no other carillon than that where the bells hang almost outside the bell-chamber, and of which the keyboard and connections are rather old, roughly installed and poorly kept up. The question of what such a carillon should play gets, naturally, even from me, a shorter answer: as the means are less, the more restricted become the possibilities. But it is remarkable how changes and improvement have been carried out in the connections between clappers and keys by means of set screws, a logical coupling and alignment of wires in the 'tuimelaar' system and an efficient placing of springs. A well installed carillon is so sensitive an instrument that it allows the finest interpretation. An audience of thousands, spread out in the evening on the streets and neighbouring places and bound together by nothing but the carillon, has in many cases strongly expressed its appreciation of the music rendered. I do not say that the approval of the crowd is the criterion of artistic refinement, but I certainly think one can say that the carillon is an exceptionally sensitive means for becoming acquainted with the impression of music and its interpretation.

Usually my father improvised for a few measures between some of the numbers of his programme. I have retained this custom, although it depends upon mood and time whether this free preluding will be short or long, or even omitted. These little fillings in are refreshing for both player and public, and they sound very good where it is desirable to separate two pieces of different character. The custom of the carillonneur beginning on time also helps the listening crowd to become quiet and attentive at once. As soon as the last stroke of the hour falls, I send out a flight of chromatic scales as a signal, and in tonal passages develop a theme, modulate and make contrasts between the smallest and largest bells. Very often I like to start very softly while the hour is still striking; then, naturally, each stroke serves as a bass note.

On market and fair days when, following ancient practice, our task is to bring a happy mood over the city, we should not be above playing popular tunes, even including street calls; for a willingness to play them, including a few variations, need not

cause fear that anyone will be annoyed at us, or that we shall hurt our name as good musicians.

In concluding, permit me to give my ideas on the arrangement of a good carillon recital programme.

Care is necessary in the selection and order of pieces. The carillonneur must realize the impression which each piece makes on the listening public: he should so arrange his recital that it creates a mood, sustains it and leaves it felt afterwards. While playing his best, considering the music both from the standpoint of the composer and that of the listening public, he should not perform in a way that baffles his audience with continuously overpowering virtuosity, or bores the public by giving a whole hour in the same style. The same care must be given to the simplest as to the most difficult pieces in the programme. The carillonneur is advised to broaden his repertory and to develop clarity as he gains experience. He will do well to keep a book of repertory provided with music classified as follows:

1. Pieces especially suitable for beginning a recital;

2. Songs, old and modern, of Flemish, Dutch, French, English, German, etc. origin; in this group are subdivided folksongs, popular songs and art songs;

3. Music of special and classical styles;

4. Closing numbers.

In the selections in no. 1 he finds material first of all in preludes, fantasies and exercises in which interpretation is combined with great virtuosity. The aim is to get attention immediately; it may happen also that the beauty of the piece wins the sympathy of the audience.

In no. 2 he presents a contrast -- a group of simple songs. The carillon is exceptionally well suited for this and the public is always grateful for such presentations.

The middle number is taken from classical music such as sonatas, allegros, rondos and minuets; this is the place for Pleyel, Steibelt, Nicolai, Richter, Peichler, Krafft etc. A performance with faultless rhythm is animating, bringing fresh variety, satisfying the musically developed listeners and making a bright point which stays in the memory.

The 4th group generally consists of melodies with a completely different character from those of the second, or at least from some of the songs of the second, so that they will make a

contrast by their origin or their style. Further, it should include characteristic pieces by such masters as Benoit, Tinel, Tchaikovsky, etc. The pieces should be arranged in order of increasing interest, so that the player works on his audience more and more, and leaves them with the deepest impression.

In the list of pieces which make a closing effect belong certain preludes and such other works as Ständchen and Ave Maria by Schubert, Träumerei by Schumann, Solvieg's lied by Grieg, Mijn Moederspraak and the 3rd Fantasia by Peter Benoit, and also certain old Flemish songs such as 's Avonds als ik slapen ga, Ic seg adieu, Ghequetst ben ic van binnen, a few French bergerettes and generally songs which can be performed with tenderness.

The question of how to raise the standard of carillon music so as to make it so beautiful that it commands respect, is naturally not answered by the less ambitious question: what should the carillon play? The highest demands can be placed on the instrument and player, the latter being required not only to have musical knowledge and taste but also to be thoroughly acquainted with the construction of carillons -- both his own and others. Until each carillonneur gains for himself the experience which brings him this knowledge, we must follow such local and individual prestige as is known to have been so far attained. Only by means of the Beiaardschool can we assure the future of carillon art, that unique expression of a common demand for beauty in our North and South Netherland provinces.

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APPENDIX III

ST. PATRICK'S BELL

Of iron, dipped in bronze. Rectangular mouth with rounded corners. Made of a single sheet of thin metal, riveted on the narrow sides. The clapper is the original one. Tradition associates this relic with Ireland's patron saint and it can with fair reliability be traced back to within a very short time after St. Patrick's death. In the Annals of Ulster, of the year 552 A. D., the Bell of the Will (Clog in Edachta, as it is named in Irish) is mentioned.

THE BELL OF CLOGHER

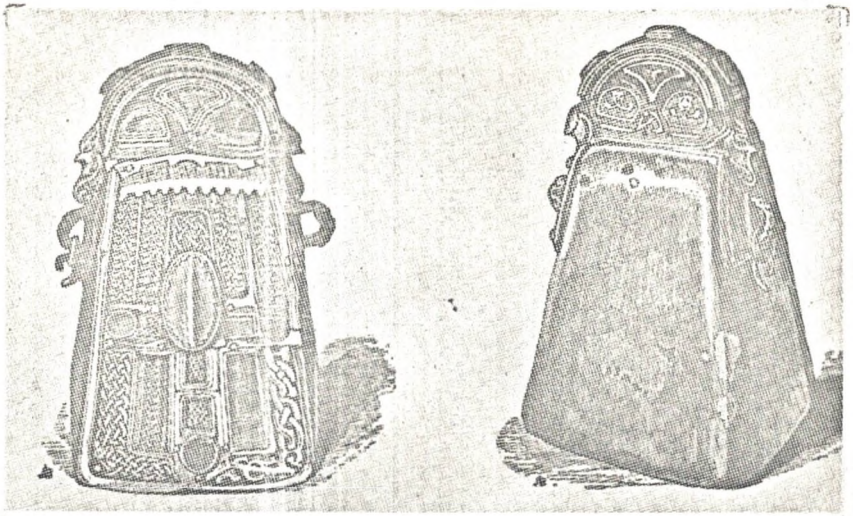
Made of cast bronze. Rectangular at the mouth. All four sides slope inwards from the mouth to the carrying handle, which is cast in one piece with the bell. There is no decoration. On one face, in Roman capitals, occurs the word "PATRICI" and on the other face the figures 1272. This, according to tradition, is the bell which was given by St. Patrick to St. Mac Carthainn, Bishop of Clogher. It was formerly preserved in a church in Donaghmore, County Tyrone.

THE LOUGH LENE BELL

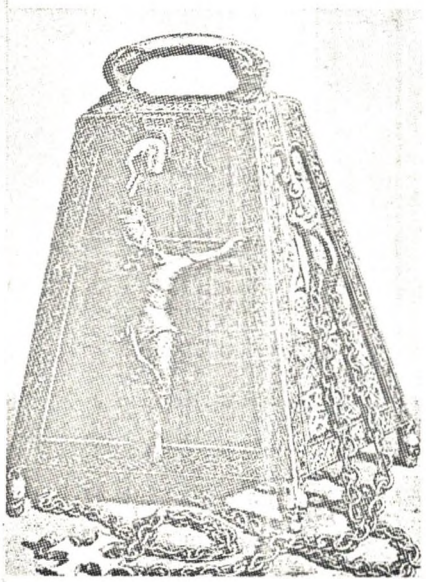
Cast bronze. Of the usual Irish shape--rectangular in cross section with all four sides sloping inwards towards the top. This is the only bell in the National Museum of Ireland which bears ornament. These consist of a Latin cross in a ring incised on each broad face and, on the same faces, a border of diagonal fret pattern, set against a hatched background along the mouth of the bell. It is difficult to date this bell since it was not found in association with any dated material. The diagonal fret design, however, occurs most commonly in the period 650 to 800 A.D. and the bell may be of this date. It was found on Castle Island in Lough Lene, County Westmeath.

THE BELL OF ARMAGH

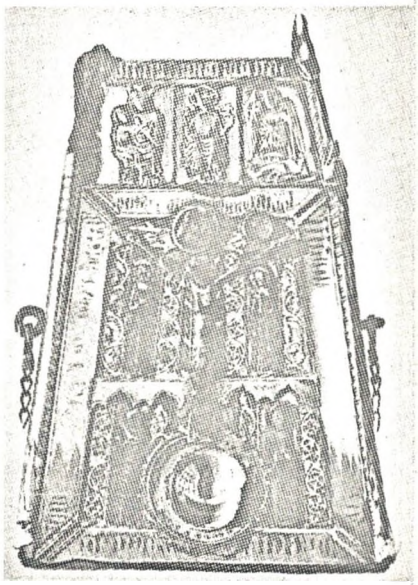
Made of cast bronze. Its handle and clapper are of iron. It is sub-oval in cross section, has a rounded top and an everted lip. It bears no ornament but there is an inscription on it requesting a prayer for Cumascach, Son of Ailill, who was steward in the monastery of Armagh and who died in 908 A. D.



19. St. Murra's bell shrine



20. Kilmichael Glassary bell shrine



21. Bell shrine of Conall-Cael

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