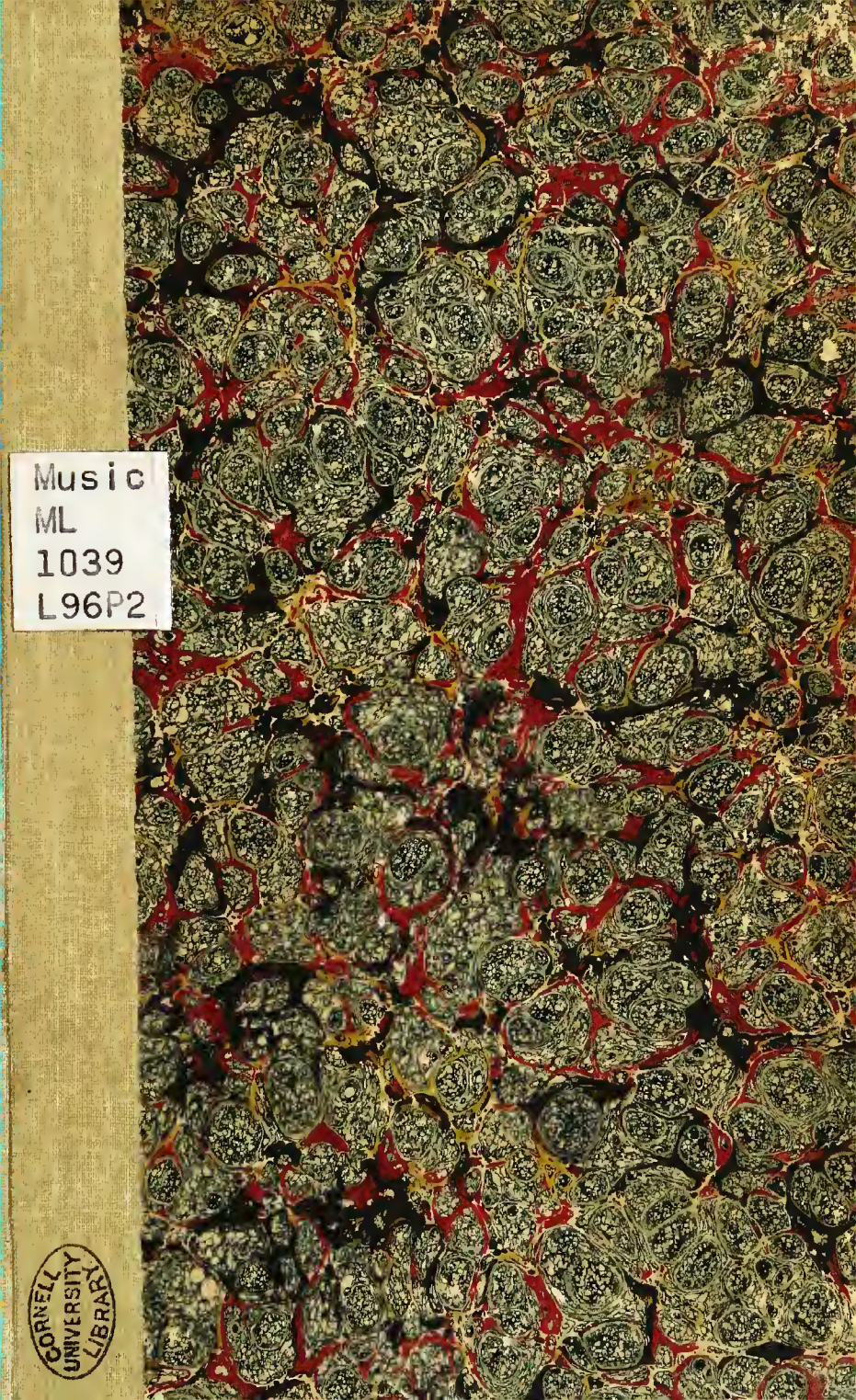

A PAPER ON BELLS

AND

MODERN IMPROVEMENTS

FOR

Chiming and Carillons,

READ BY

MR. GEORGE LUND,

BEFORE THE

SOCIETY OF ARTS, LONDON,

March 6th, 1874,

LIEUT.-COL. SIR JAMES HOGG, M.P.,

Chairman of the Metropolitan Board of Works

IN THE CHAIR.

On Bells, and Modern Improvements for Chiming and Carillons.

I FEEL that some words of apology are due from me for presuming to read a paper before so learned a society as this; but upon the scientific part of the question I most candidly admit that I am not equal to entering at present, being quite content to quote the opinions of others, far more competent than I to express an opinion; but I venture to think that, upon the practical part of the bell question, and the mechanical means used for producing the best musical effects upon them, I may be heard with pleasure and interest by my audience generally; and to some of my hearers who, like myself, are enthusiastic in such matters, I may be able to impart some information which may prove of value in furthering the common object we have in view, the revival of the love of bell music, which, until within the last few years, has fallen considerably in public estimation, on account of the rude and unsatisfactory machinery used in its production. It must be distinctly borne in mind that, although special reference only is made to the machinery as applied to hemispherical bells, it is quite as applicable to the church bell or any other shape of bell, modifications only being introduced to suit the weight of hammers to be used to bring the proper tone out of the bells. I propose to divide the subject of this paper into three heads, giving, firstly,

some information about what came under my notice while making a hurried tour through Belgium, the home of chimes; then, secondly, touching briefly upon bells, their manufacture and uses in our own country, to come. thirdly, to the more immediate subject of this paper—hemispherical bells, and modern improvements in the machinery of chimes and carillons. The first town of importance on the route, viâ Dover, Calais, and Cologne, is Ghent, where there are 44 bells, a tune being played every quarter of an hour, once an hour being not enough to satisfy the insatiable desire of the Belgians for bell music. My impression on first hearing them was, that they were played by some means loud and soft, but I soon decided that that could not be without a system of dampers being used, and that I knew had not, and has not yet, been successfully, if at all, applied to bells. It is a subject to which I intend to give attention as soon as possible, and I hope any difficulties, should damping be found to be useful, may be overcome. I must say I do not believe it to be a Herculean task. We have already sketched out a very simple method of damping by apparatus attached to the hammer, which could be easily altered to be worked by a pedal or by an extra key, so that a bell could be allowed to sound out for any length of time or damped instantly; and I have no doubt that most intricate and difficult effects of melodies, with running accompaniments in the base, could be played in this way with perfect distinctness; the great fault with all the Belgian music being its indistinctness.

The machinery used in Ghent is on the same principle as in all the other towns, and is the same as has been used in England till within the last few years. A large barrel of either iron or brass, with pins in it of large size to catch upon the ends of the levers, to which are attached the hammers which strike the bells, to raise them, and let them fall again immediately on the

bell, is driven by a smaller drum and wheel, round which is wound the flax or iron wire rope, to which is attached the weight, which is the motive power. At Ghent, the music drum is made of brass, with square holes punched into it, and in these holes iron lifting-pins are placed. The surface of the barrel being divided by the square holes into intervals for crotchets, quavers, and semi-quavers, it is a matter of no very great difficulty to arrange the tunes; and when it is desired to remove them for a change of tune, it is easy to knock them out from the inside, and to put them in such other holes as the nature of the notes to be produced may require. The ropes here are of flax; the driving weight is 300 lbs., and is wound up twice a day. There are as many as four hammers to some of the bells, and none have less than three. The brass drum is about six feet in diameter, and, when in motion, reminds one very much of a water-wheel, so ponderous does all the machinery look. It was constructed by Charles Nolet, a native of the town, and I have no doubt his fellow-townsmen are very proud of his memory, for he must have been long since dead. The next place, *en route*, is Bruges, where the machinery is on a much larger scale than even at Ghent, the barrel being eight feet in diameter, 48 bells, and as many as six hammers to some of the bells—190 in all. The machiney was constructed by Antomusde de Hondt, of Bruges, as far back as 1748, and of late years iron wire has been substituted for flax rope. The weight has to be wound up every two hours, a man living in the tower for that purpose. The clock here is worthy of passing notice, being of a very large size to carry the hands for the dials, which are 19 feet in diameter. It has a gridiron pendulum, which is supposed to compensate for changes of temperature, but this it certainly does not do to any satisfactory extent. It strikes the hours at the hour and half-hour, on a different bell at the half-hour to

distinguish them, and a tune is played at each quarter. As at Ghent, there are small clappers fixed inside the bells, by which they are played upon by hand. The performance is done in this way. The man who is about to distinguish himself regularly prepares as for a pugilistic encounter. He takes off his coat, waistcoat, and hat, puts his long hair learnedly off his forehead and behind his ears—at least the man I saw did—looks intently for a few moments into the corner of the room, puts on a regular pair of boxing-gloves in the greatest possible hurry, evidently for fear that the brilliant melody should escape him, sits himself down in front of long rows of pegs and pedals, and bangs away at them as hard as ever he can go, first up, then down, now in the middle, now both ends at once—and I believe the whole lot would have gone down at once if he could have managed it—legs and arms all going in a perfect frenzy, but there being many more pegs than arms and legs, he could not manage more than a certain number at a time. How thankful the Antwerpers ought to be. Now for the result produced—a great deal of clatter and fatigue, but very little music. Noise and jingle, most lovely to those who like it; but I am one of those unappreciative sort of people who do not think that music consists in a thundering noise and clatter. Dr. Gatty, in his "History of the Bell," says, upon this subject:—"The Carilloneur uses both hands and feet in executing the sprightly airs which charm the inhabitants of the cities of the Low Countries. The pedals communicate with the larger bells for the base; and the keys upon which the treble notes depend are struck by the hand edgeways, the little finger of the player being defended by a thick leathern stall. It requires considerable strength, as well as celerity and skill in the player, for unless a violent blow be given to the key, only a weak sound would be produced;" and Dr. Burney (in his "Present State of Music in Germany,

1772,") says:—"The want of something to stop the vibration of each bell at the pleasure of the player, like the valves of an organ, is an intolerable defect to a cultivated ear, for by the notes of one passage perpetually running into another, everything is so inarticulate and confused, as to occasion a very disagreeable jargon." He also says:—"The carillons are said to be originally of Alost, in this country (that is, Germany), and are still here and in Holland in their greatest perfection."

The next town I visited, where there are chimes, was Antwerp, where there are 48 bells. The bells are swung as well as chimed on by the machinery, which was made by Van Hoof in 1786. The weight is wound up twice a day. These people seem very fond of winding up weights, nothing less than twice a day suits them, and, in one instance named, every two hours. The next and last in my route was Namur, where there are 54 bells. The machinery was made by Nolet, of Ghent; of the date I have no note, but I should say it was decidedly more recent than the machine by the same maker at his native town, the whole arrangement of the bells and hammers and machinery being much more perfect and mechanical. The music was taken in excellent time; there was a distinct melody running all through, with a most judiciously arranged accompaniment in the base.

There is at Louvain a large bell foundry, where, I believe, nearly, if not all, the Belgian bells have been cast. Van Acholdt is the proprietor. At the time I visited him he had nothing particular in hand, but a few years ago he sent a large peal of 42 bells to this country for Boston, in Lincolnshire, which are considered to be very good. The process of manufacture of English bells, which I am now about to describe, will apply equally to the German bells, and I need only mention here that many people consider them superior in tone to ours. I believe that a great deal of this apparent superiority

is due to the number they use. Take them singly, and undoubtedly they are thin in quality of tone.

There is a most excellent work about bells, edited by the Rev. H. T. Ellacombe, and called the "Bells of the Church," a supplement to the "Church Bells of Devon," and I was so much struck with the easily-understood description he gives there of bell founding, that I think I cannot do better than give it in his own words. He says:—"It will be interesting to the general reader if I describe the modern process of bell casting. This I am the better enabled to do by taking the establishment at Whitechapel, the oldest in London or in England." Before describing the process of casting a bell, it may be well to state that bell-metal consists of an amalgam of copper and tin, in proportion of about three parts of copper to one of tin. There are, of course, various trade secrets as to the exact proportions of the different metals necessary to constitute a first-rate alloy. Mr. Denison, in his book, says that, after many experiments, he has come to the conclusion that the proper composition for bells is thirteen of copper to four of tin.

There is no great mystery, after all, in the bell-founders' art, but extreme care is necessary, in order to produce a good toned bell, that all the preliminary operations should be conducted with the greatest exactness. Passing through various yards at the Whitechapel Foundry—in which are stored quantities of old timber, old bell-metal, and a multitude of odds and ends, in the shape of cannon and great masses of old copper destined one day for the furnace—we arrive at the moulding-room. In describing the casting of a bell it will be necessary to observe that it is nothing more than a layer of metal which has been run into the space between the mould and its outer covering and allowed to cool. Figure 2 will explain this very readily. Here we have a section of a bell as it lies in the pit during the process of

casting. The various parts of a bell may be described as the body, or barrel; the clapper, or striker hanging on the inside; and the ear, or cannon, on its top or crown, by which it is hung in its chosen position in the tower.

The following description applies to all bells, large and small, the various modifications in the shape, &c., not interfering with the principle on which it is manufactured. The first principle to be observed, is the construction of the shape or form of the future bell, so as to ensure that due harmony in all the parts which shall give to it the proper degree of tone and vibration. Various theories have obtained in different countries, and among the different founders of our own country, as to the best proportions for bells; but the following scale has been proposed and generally followed at this foundry as coming nearest to perfection. Taking the thickness of the sound-bow or brim—that is, the part where the clapper strikes—a bell should measure in diameter at the mouth, fifteen brims; in height to the shoulder, twelve brims; and in width at the shoulder, seven and a-half brims, or half the width of the mouth. These proportions, however, are very variable, and depend greatly on the taste, experience, and skill of the founder, an approximation merely being arrived at in these figures. Mr. Denison says:—"The most essential point of all to be attended to in ordering bells is to require absolutely, and in spite of all protestation of the founders, that none of them, when finished, are to be thinner in the sound-bow, or thickest part, than one-thirteenth of the diameter." I know that some good old bells are a little thinner, but I never saw a new one that was less, and had at the same time anything of the soft and sweet tone which which church bells ought to have. I can only account for the old ones bearing to be thinner, though by no means so thin as many modern ones, by the well-known greater softness and toughness

of the copper of old times, when they smelted less metal out of the ore. The small bells of a peal are always rightly made thicker in proportion than the large ones, and will run up one-eleventh of the diameter, the large ones being one-thirteenth. I would here observe that Mr. Denison goes most minutely into the why and the wherefore of the proportions of metal and the shape of bells; but I have selected Mr. Ellacombe's description of bell founding, because I have thought it would be more generally understood. To the searcher after information, both books are invaluable, one treating exhaustively on the constructive part, and only slightly on what I may call the archæological part of the question; and the other exhaustively on the archæological, and only slightly on the constructive. The size and proportions, then, of the future bells being ascertained, the making of the mould is proceeded with. The outer form of the core, by which the inner shape of the bell is determined, is made by means of a crook, which is made to revolve on the clay, &c., of which the mould is composed. This crook is a kind of double compass, the outer leg of which is in two parts, formed of wood and metal. The inner part (of metal) is cut or curved to the shape of the outside of the core, or inside of the intended bell; and the outer part (of wood) to the form the outside of the bell is to be made. This crook and compass is to move on a pivot affixed to a beam above, and its lower end is driven into the ground. In the case of very large bells, the mould is perfected in the pit in which they are to be cast. The crook is driven by the hand of the moulder, and the moulds being composed of plastic clay, &c., the form of the inner side of the bell is defined by a few revolutions of this simple machine. Thus is formed the core, or inner mould. The cope, or outer mould is formed in much the same way, except that its inner surface is smoothed to form the outer side of the bell. The core is first roughly

built up of brickwork, with a hollow in the centre. It is then plastered over with soft clay, &c., and moulded as described by the action of the crook, and is afterwards dried by means of a fire in the hollow mentioned. When baked sufficiently hard, it is covered all over with a size of tan and grease. Over this size a coating of hay bands and loam is laid, the exact thickness the bell is intended to be made; on this thickness the outer leg of the crook—the inner leg which formed the core having been removed—is made to rotate, and so forms the shape of the inside of the cope or outer mould. This thickening being thoroughly dried, upon it is formed the cope, or outer mould, upon the outer surface of which are formed ledges, by means of which, when dry, it is raised, and the thickening destroyed. Both are then retouched, any device or inscription being impressed upon the inside of the cope; it is re-lowered, and the hollow space between the cope and core is, of course, the exact shape the bell is to be. The head and staple to hold the clapper being now fitted above all, the mould may be said to be complete. A sufficient number of moulds being now formed for the number of bells to be cast, the pit is filled in with earth, firmly rammed down, to prevent the copes rising when the metal is run in. The furnaces are now lighted, the metals in their proper proportion are melted—sometimes as much as twenty tons at a time—and from time to time tested—till found to be of the right temperature, when the furnace doors are opened, and the molten metal directed through properly constructed channels to each mould in succession, till the whole number of bells is cast. Sufficient time is allowed for cooling. The earth is dug away from around the moulds, which are then destroyed, the bells being taken to the tuning room, where they are tried for note; and when tuning is necessary, which is almost always the case, the bell is securely fixed into a wooden frame by

means of wedges, underneath a steam cutter, which cuts as much as may be required, either from the inside of the bell, in the region of the sound-bow, to deepen the note, or from the edge of the lip to sharpen it.

The earliest notice of a belfry and peal of bells is contained in the following passage :—Egelric, Abbot of Croyland (who died 984) in the time of Edgar, caused a peal of bells to be made for his Abbey, to each of which he gave names, which it is needless to give here ; and the celebrated "Benedictional of St. Ethelwold," in the library of the Duke of Devonshire, furnishes us with an earlier instance of a belfry with four bells, namely, about the year 980. From that time to the present, bells of all sizes, shapes, and weights, have been cast ; and I think that a few moments may not be unpleasantly spent in enumerating some of the most famous. The largest bell in England is, as you are doubtless aware, "Big Ben," the clock bell at Westminster ; it may not be equally well known that it derives its name from the fact that Sir Benjamin Hall was then Chief Commissioner of Her Majesty's Office of Works when the bell was first cast, and his name inscribed on it ; it was named after him, Ben, and from its size was naturally called big ; hence the name, "Big Ben." It bears this inscription :—"This bell, weighing 13 tons, 10 cwt., 3 qrs., 15 lbs., was cast by George Mears, of Whitechapel, for the clock of the Houses of Parliament, under the direction of Edward Beckett Denison, Esq., Q.C., in the 21st year of the reign of Queen Victoria, and in the year of our Lord, 1858." It was contracted for that the bell should bear the blow of an 8 cwt. hammer, but after the clock had struck on it for a few months cracks showed themselves, and, upon examination, it was found that the metal was porous and the casting defective. The striking was then removed to the fourth quarter bell, upon which the hours were struck for two or three years ; but after many complaints of the confusion, the

striking on the big bell was resumed (November, 1863 with a lighter hammer, the bell being turned a quarter round by the button or mushroom head by which it is hung. The four quarter bells were cast by Messrs. Warner without any known defect, and are remarkably good. I may here give you some information which may be new to you, and at the same time bear testimony to the remarkable time-keeping of the clock. We receive from the Royal Observatory at Greenwich, by electric current, a time signal every hour—and I show upon the table the instrument we use for registering it—having found it extremely inconvenient to be on the look-out exactly at the hour, failing which the signal was lost. It is the invention of a brother of mine, improved by myself only to this extent, that instead of using an ink chronograph watch we use a stop chronograph; and for the information of those who do not know the difference between the two, I would say that in one the seconds-hand is double, and that when the signal comes it draws the upper hand through the reservoir of ink in the end of the lower hand, and so marks the error of the watch on its dial or face, and that the hand is constantly moving. In our chronograph the hand can be started from zero and allowed to travel as long as desired, can be stopped and again brought to zero for another start, each being done by pressure. Having placed the hand at rest, we put the watch into the instrument and leave it. At the next hour the signal is sent from the Royal Observatory, and the hand of the watch is started absolutely to Greenwich meantime. We can then, at our leisure, compare our regulators. The wire through which our signals come is used by the Westminster clock once each day, to transmit a register of its time to the Astronomer Royal at Greenwich, and to Mr. Dent, in the Strand. When we want to compare "Big Ben," we only replace our watch, and let the clock signal (being the second pressure) stop the hand. When-

ever it stops to the right or left of zero, so is it fast or slow of time. If it stops at zero it is, of course, correct time. It is very rarely indeed that we find it many seconds out. The next largest bell in England is "Peter of York;" diameter 8 feet 4 inches, height 7 feet 7 inches, weight 12 tons 10 cwt.; the note is F sharp. The next great bell is the "Mighty Tom," of Oxford, 7 feet in diameter, and weighing 7 tons 12 cwt. The note is generally considered to be A, but being faulty in some parts, the tones vary, and some say it gives out five notes. Rather a cheap way that of getting the effect of a peal of five bells. Three unsuccessful attempts were made to cast it in 1681; twice it wanted metal enough to make out the canons, and the third time it burst the mould and ran into the ground. It was at last, can I say successfully cast, with its five notes, by a London bell-founder, named Christopher Hodson. In 1682, it was moved from the church to the gate house, and, on the 29th of May, 1684, it first rang out, between eight and nine at night, from which time to this a servant tolls it every night at nine, as a signal to all scholars to repair to their respective colleges and halls.

There is a great bell at Lincoln Cathedral weighing 5 tons 8 cwt.; note A. This, and the two quarter bells, were cast from the old 1610 bell, and six other bells from the rood tower, called the Lady bells, by Mears, of London, in 1834. St. Paul's Cathedral has a large hour and two smaller quarter bells, none of them anything to boast of, in the south tower. There is, however, in the north tower, a bell which bears the inscription:—"Made by Philip Wightman, 1700." The diameter is only 49½ inches, and the thickness 3¼ inches, yet the tone is most deep and sonorous, and I think, for its size, one of the most pleasing to the ear I have ever heard. Having had occasion to try it several times, the impression remaining of it is a most pleasing one, which I cannot say of

the three other bells; the quarter bells are specially poor and lacking in quality of tone. There are also large bells at Leeds Town Hall, St. Dunstan's Canterbury, and at Glasgow. One of the latest additions to the large bells in England is at Worcester Cathedral, for the new clock to strike on, and for occasional tolling. It is hung on the balance-beam principle. The gudgeons or pivots on which the bell moves are wedge-shaped, and roll on hand brasses, very slightly hollowed; the friction is thereby so little that the bell can be tolled by one man with one hand, although it weighs four tons and a-half, a lever being attached to the stock instead of a wheel, which is necessary under some circumstances. It was so tolled for service, for the first time, by Mr. Denison and the Rev. H. T. Ellacombe, on Sunday, the 17th January, 1869, in the company of the Rev. R. Cattley and others, and it is owing to the last-named gentleman's indefatigable efforts that the peal has since been made up to fifteen bells, and machinery provided to play tunes upon them.

I may here be permitted to publicly thank him for his extreme courtesy to me on the occasion of a visit which I lately made to Worcester. Anything more perfect in the way of general arrangement of bell framing to support and carry the bells, of fittings in the bell-ringers' floor, and evidence of heart and soul enthusiasm of the master mind in the work, from floor to roof of the tower, is not to be found. The bells, made by Messrs. Taylor, of Loughborough, are undoubtedly very fine, and the clock, made by Messrs. Joyce, of Whitchurch, is a specimen of English work of the highest order.

In Mr. Ellacombe's book, much more and most interesting information will be found about big bells, in this and other countries, large peals, &c., and recommending it to your notice, I pass on to "The various uses to which bells have been put." The two most important of these, and the only two which I shall speak

of, are change ringing, by ringers swinging the bells, and chiming tunes by machinery. Seventy or one hundred years ago, ringing was a much more popular and fashionable pastime than it is now. The exact date is uncertain when the art of ringing a number of variations on bells was first practised, but probably about the commencement of the seventeenth century. Long before that date, no doubt bells had been rung, but only in rounds, that is, in the same rotation each time. The earliest known record of a ringing society is to be found in a manuscript in the library of All Souls College, Oxford, entitled, "Orders conceyved and agreed upon by the company exercising the arte of ringing, knowne and called by the name of the Schollers of Chepezyde, in London, begun and so continued from the second day of February, anno 1603." This society appears to have existed down to 1634. Three years afterwards, another society was formed, called the College Youths, records of which exist down to 1755. There is at the present time a society of the same name, which claims relationship, rightly or wrongly it is not necessary here to inquire, with this ancient and aristocratic society. I do not suppose that much harm will be done either one way or the other; it is enough for my purpose to say that other societies have been formed, two numerous to mention; that some have flourished more or less—the majority, I imagine, less; some have died natural and some unnatural deaths, but still the College Youths, in name at least, exist. The aristocratic element of the society has now, however, given way to respectable tradesmen, clerks in various capacities, and skilled artisans (I quote Mr. Ellacombe's words), with a very fair sprinkling of clergymen, barristers, and gentlemen of no occupation (but bell-ringing, I suppose). They, however, gave most practical proof of the good ringing qualities they possessed in 1862, by ringing, on the 27th April in that year, a true and complete peal of cinques,

on Stedman's principle, consisting of 8,580 changes, in a most masterly style, in six hours and forty-one minutes, on the noble bells of St. Michael's, Cornhill, being the greatest number of changes ever rung in that method on twelve bells. The number of changes which can be rung upon a given number of bells is something extraordinary, and should any of my hearers care to inquire into the mysteries of the art, I would recommend them to get a book called "An Introduction to the Early Stages of the Art of Church or Hand-bell Ringing, for the use of Beginners," by Charles A. W. Troyte. He there gives, as the number which can be rung on eight bells, at 40,320, time required to ring, one day four hours.

On	9 bells,	362,880	Time	10 days	12 hours.
,,	10 ,,	3,628,800	,,	105 days.	
,,	11 ,,	39,916,800	,,	3 years	60 days.
,,	12 ,,	479,001,600	,,	37 years	355 days.

It is truly a most mysterious art. I have tried to master its intricacies so as to be able to write the changes for our chiming barrels, but at present have made very little progress. The book being only an introduction and for the instruction of beginners, what is to follow after must be wonderful indeed. I will read you just one chapter as a specimen. In Chapter IV, Mr. Troyte says, "Having, in the last chapter, I hope, explained the working of the Grandsire method, I now call the learner's attention to the most beautiful of all five-bell methods. It is beautiful in its work and beautiful in its music, and once learned, I think not much harder than the Grandsire method. It was invented by a Mr. Fabian Stedman, about the year 1640, and has since then become most justly popular among ringers. The great beauty of it no doubt consists in the two facts, that bells come to lead at back stroke as well as at hand stroke, and that double dodging is always going on behind. The foundation of the

principle is that three bells should go through the three-bell changes, as given in Chapter II, while the other bells dodge behind at the completion of each six changes, one bell coming down from behind to take its part in the dodging. But it is not possible to ring it by this plan, therefore it is necessary to give certain further instructions, and before I do so, I wish to call the learner's attention to the fact that the treble is no longer the easiest bell to ring, but does exactly the same work as the other bells; this forms one of the great difficulties of the method." Then come the rules for Stedman's principle. The work of each bell is described as divided into three parts, viz., the quick work, the dodging, and the slow work, each being minutely described. He then goes on to say, "In short, and for the sake of making it easy for learning by heart, in coming from behind make 3rd's place, lead a whole pull, strike one blow in 2nd's place, lead another whole pull, make 3rd's place, lead one blow, make 3rd's again, lead another blow, make 3rd's again, lead a whole pull, one blow in 2nd's, and another whole pull, make 3rd's, and up (or out)." After describing more dodging in and out, half turns and whole turns, odd, even, slow, and quick sixes, he says, "I have now, I hope, explained the following terms, and shall use them hereafter without further explanation :—

Quick work.	First and last whole turns.
Slow work.	First and last half turns.
The dodging.	Going in quick.
Odd sixes.	Going out quick.
Even sixes.	Going in slow.
Slow sixes.	Going out slow.
Quick sixes,	

"It is necessary that these terms should be thoroughly understood before the learner attempts to go further." I do not think any of us do thoroughly understand—I can answer for myself—and we will therefore take such sound advice and dismiss the subject, and pass to another use to which church bells have been put, viz.,

for the playing of tunes upon them by machinery. These machines have been most aptly described as "rather rough, the barrel-end has a rope coiled round it, and it drives two or three wheels, ending in a fly, to regulate the velocity." This meagre description exactly conveying the impression of their meagre effects. There are many of them spread all over the country, in various stages of decay. I will only mention three which have come under my own immediate notice. The first was, until the restorations were commenced, in full force, on eight bells, at St. Alban's Abbey. One tune after another had gone to rest, till at last "The Curley-headed Plough Boy" alone remained to tell his tale of past glories. He, at last, has been put in a corner, where some friends of mine, who live close to the abbey, fervently hope he will remain for all time. At Southwell, where there is a minster second only to Lincoln cathedral in interest as a specimen of early Norman architecture, there are chimes. Here the only remaining tune is "God Save the Queen." The last I came across accidentally, at Kettering. There I could make nothing of the tune at all, and ceased to be surprised at it when told, by an old inhabitant, that I was no exception to the rule. He was the only person who knew that it was made up of the "Old Hundredth" and "Caller Herring," that they were the two last surviving tunes twenty odd years ago, that they had not been played for about that time till a few years since, when the machinery was then put in order, and he supposed that, in the interval, they had become so inextricably mixed up together, that separated they could not be. He thought it would have been better to have left them alone. We did not disagree upon the point. No doubt there are many machines, constructed upon the old principle, which continue to play tunes as well as ever they did, proper care and attention having been always bestowed upon them; but bad is the best. If anyone should

wish to hear a melancholy exhibition of what such machines of comparative modern construction can do, let him go and hear the Royal Exchange chimes play, at 9 A.M. and 6 P.M. Can nothing be done to remove the reproach that the wealthiest city in the world, at its Royal Exchange, presents such a contemptible specimen of discord!

We now come to the more immediate subject of this paper—hemispherical bells, and modern improvements in the machinery for carillons and chimes—and I would wish it to be distinctly understood, that I do not for one moment desire to be understood to say that this shape of bell will supersede, to any great extent, the church bell shape, or that the power of the tone of one is to be compared to the power of tone of the other. In the hemispherical shape, a $4\frac{1}{2}$ cwt. bell will produce the same note as 25 cwt. in the church bell shape, and it is quite obvious that $4\frac{1}{2}$ cwt. cannot produce the same volume of sound as 25 cwt. But what I do say is, and my firm have proved it in practice, that hemispherical bells, in peals of eight and more, can be used most advantageously in places and spaces, with all the machinery necessary to produce the required effects of change ringing, quarter striking, and tune playing, where the other shape could not have been used, first, for want of space, and, secondly, in many instances—a most serious consideration—on account of the cost.

That they and our machinery will prove useful in providing for a want which has been greatly felt of late years, viz., the supply of bells and filling the place of ringers in neighbourhoods were they are not to be found, I have no doubt whatever; and I am also of opinion that a very large field for their use exists in towers and turrets attached to country mansions. Their sweetness of tone is eminently suited for this purpose, as all the charming effects of bell music may be obtained from them without the tinkling sheep-bell sound of

light peals, or the impossible expense and over-powering sound, at short distances, of peals of the ordinary shape, sufficiently heavy and deep in tone to give good effects. They also possess this very great advantage over church bells, that through any number they retain their musical continuity, that is to say, from one octave to another, even in chromatic scales, they can be perfectly tuned, whereas in church bells, beyond a certain number, generally over ten to thirteen, they cannot be made—to use a technical term—to fit. At Worcester, for instance, the two smaller bells in playing the music are decidedly out of tune.

It is not proposed to enter, in this paper, into the question whether or not hemispherical bells are constructed upon scientific principles. I cannot really tell you upon what principle they are constructed. I have never put the question to the founders of them, for the (to me) satisfactory reason that I do not believe they would tell me if I did. At present, I have quite enough to do to make use of them when made. All I propose to do is to give some information respecting accomplished facts with regard to them and the chiming machinery which we have made and are making, under the patent of Mr. Imhof, taken out on the 29th September, 1866—information which we have ventured to think may prove to be interesting to our fellow-members in this society. From time to time we have applied them in isolated cases to clocks, with invariable success, but it was not till 1870 that we had an opportunity of ordering a peal of sixteen, for a tower at Colonel Tomline's, Orwell Park, a few miles from Ipswich. The smallest in the peal is 1 foot 4 inches in diameter, and weighs 3 qrs. 13 lbs., from which they run down to the lowest in the peal, 3 feet $\frac{1}{8}$ inch in diameter, which weighs 6 cwt. 19 lbs. The hour bell is 3 feet $6\frac{1}{2}$ inches in diameter, and weighs 9 cwt. 2 qrs. 5 lbs. The peal is in the key of E flat, with two half notes, the key which

we consider best adapted for bell music, and was the first of that number and size ever cast. The whole weight is about two and a-half tons, and the bells are arranged in two tiers of wooden bell-frame, the cranks leading to the machinery being placed in the centre of the two, and leading right and left. The whole is contained in a space 7 feet 9 inches by about 11 feet high, tier above tier, each bell in its own compartment, so as not to interfere with or stifle the sound of its next door neighbour. When the bells arrived at the foot of the tower, it was unanimously considered by the builders' employés engaged on the estate that the tower would not hold them, but, to the intense astonishment of every one, the bell-frame and the bells were all fixed in their places in less than a week, with two feet out of the nine unoccupied. Our first object, in undertaking work of this kind, is to see the place the bells are to go in, and then to obtain, from the architect of the building, tracings of the bell-chamber. We then design and carefully draw to scale the bell-frame and bells, knowing approximately their dimensions, so that they are as good as placed, for all practical purposes of construction, in the tower before they are actually cast, and we are then able to state, with the greatest accuracy, what sized bells can be used. The facility with which these bells can be fixed in their places is one of their numerous recommendations. A hole is drilled through the crown $1\frac{1}{8}$ of an inch diameter, and through this and the cross-beam of the bell-frame which is to carry it is passed a bolt, secured by a nut and washers, and in this way each is fastened to its own beam, upon which are fixed the hammers and counter-springs to prevent chattering in the blow, so that, falling as it does from the centre of the bell, the full force of the blow of the hammer falls upon the bell. The machine which we manufactured and applied to these bells, chimes the Cambridge quarters the same as the Westminster clock, and plays one of

seven tunes twice over or not, at will, each third hour, with one weight and one train of wheels, but does not strike the hours. A clock being already there, it was thought desirable to alter that for the purpose. It may be here observed that we are making, by gracious command of Her Majesty the Queen, a machine for St. Mark's, Victoria Park, which does all three with one weight and one train of wheels, a description of which I shall give later on. The patent, under which these machines are manufactured, is the sole invention of Mr. Imhof, and consists in the discharge of the hammer upon the bell by means of a pin in a wooden barrel, and the provision of a cam action to again raise it to the catch from which it was discharged ; thus doing away with the difficulty which is experienced in preventing the wear of the pin in the barrel, and the end of the lever in the old principle, where the hammer is raised by the pin in the barrel acting upon the end of the lever to which the hammer is attached, and so lifting it and allowing it to again fall upon the bell, and strike the blow ; thus, from the very first, two defects from wear arise—the pin and lever both wear, and the time of the music and draught of the hammer are consequently affected. Mr. Imhof's plan is now universally acknowledged to be the only one suitable for the purpose of chiming machines. No doubt many improvements have been made since Mr. Imhof designed the first machine, and I am sure that he most readily admits it, but at the same time the fact should not be lost sight of that to him alone is due the credit of inventing the separating of the discharge of the hammer from the lifting pin, and it is this which constitutes the mainspring of all the improvements which have been, from time to time, introduced.

I shall now proceed to give a description of the machine at Ipswich, and as I propose to show you the principal improvements which we have made from stage

to stage of our progress, I must preface my remarks upon this part of my subject by referring to the first machine we made, which we do not now use. Its great defect—and one which invariably proves fatal to accurate time-keeping in any self-acting instrument which has rough work to do—is that the barrel is made to revolve by means of an outside driving-wheel fixed on to the main shaft of the weight-drum, and geared into a wheel of a similar number of teeth, and upon the shaft of which was fixed what is called the carrying-arm, which carries round the musical barrel one revolution of the drum, thus being equal to one of the barrel. Let the pivots of these two shafts fit the holes in which they work, and let the depths of the wheels be pitched as accurately as possible, and the working of the teeth one into the other be quite perfect tooth and space, and yet in a very short time wear will begin to show itself, the wheels will begin to rock, and the machine for time-keeping purposes becomes no better than one constructed upon the old principle. A barrel which can be set back by any unusual pressure cannot keep good time, for it not only retards the note which it is discharging, but with the spring it gets with the set-back, it shoots forward to the next pin, and discharges it as much too soon as the last one was too late. This will be evident to the most casual observer. This machine is constructed to strike the hours and quarters, and to play a tune twice over every third hour with one weight and one train of wheels. There are three key-frames constructed in the same way as the key-frame of a self-acting organ, the key discharging the hammer on the bell instead of opening the valve as in an organ. Two are for the music, and one small one for the quarters, placed for convenience and saving of room in the centre of the two. They are all connected together, and are so arranged, that when the two are down, playing the music, the quarter frame is lifted, and the pins in the barrel cannot touch the quarter

keys, and *vice versâ*, the quarter frame being down, the music-frames are up ; the striking of the hours is also ingeniously arranged for, but to this I shall refer later on. As previously stated, we have abandoned the driving of the musical barrels by outside wheels, and now always drive them direct from the shaft, upon which the weight-drum works, and to which is fixed the main wheel of the machine, by making it project sufficiently through the bracket in which it works, to allow of the carrying-arm being fastened to it. The carrying-arm is, as its name implies, that part of the machine which gives motion to, or carries round, the musical barrel, the main shaft passing into the centre of the barrel, and the carrying-pin also entering it as near to the outer circumference as possible, both being accurately fitted, and the action of the barrel being only backwards and forwards, not being circular, the wear, even in the course of years, is very trifling, and can be rectified at any time by simply putting a new back brass to the barrel. This was the first great improvement. Our next endeavour was to avoid, in the striking of the quarters, so much loss of fall of weight, one turn of the barrel, equal to a fall of 2 ft., being used for the striking of the quarters in one hour alone, in the first machine. We therefore separated the quarter barrel from the musical barrel, making the quarter barrel revolve only twice for the quarters of three hours, thus saving one turn, equal to two feet of fall, every three hours, equal to a saving of sixteen feet in the twenty-four hours, an enormous saving in such matters In this machine, as in the first, the catches are released by a key in a key-frame, and a difficulty presented itself. How could we get over the pins discharging the hammers for the music at the same time as the quarters, without lifting the key-frame, which is very heavy and cumbersome to deal with ? We soon decided that a simple plan was to keep the musical barrel still, till required to play the tune, by holding it free of the carrying-pin in the

carrying-arm, and successfully accomplished it in this way. Instead of having a spring to bear on the end of the pivot of the barrel, we substituted a weight working over a pulley, and attached to a lever, by which it can be lifted or allowed to fall according to whether the barrel is required to revolve or not. We put a spring at the other end of the barrel, where the main-shaft enters, so that when the weight is lifted this spring pumps the barrel away from the carrier, and it is held in the proper position for the pin to pick it up again the next third hour by a piece of steel in its outer edge entering a notched piece of iron. The weight when raised is held by a catch, which is withdrawn just before the last quarter change at the hour is being struck, by a pin in the quarter barrel. It then falls, and brings the musical barrel to bear against the end of the carrier-pin till it reaches the notch cut in the brass rim, arrived there the machine stops, the barrel is drawn by the weight to the proper depth, according to the tune to be played, and it only awaits release from the clock at the last blow of the hour to start and play a tune through twice. This having been done, the weight is again raised by a small roller in the main wheel of the machine, and the barrel remains at rest for three hours more. There are seven tunes played, a different one at each third hour or not at will; and here again the small barrel plays a simple, yet most important part. The tunes are changed by shifting a seven-star snail, as in an ordinary musical box. This snail is shifted by a double action lever. A small roller is fitted to the carrying-arm, which at each revolution comes in contact with the "V"-shaped end of the lever, presses it down, and, so doing, raises the other end of the lever, which in its turn shifts the snail. To prevent this being done the first time round, a short spring lever is made to hold the pushing end of the snail-shifting lever away, and it is only when it is required to change the tune that a pin in the quarter barrel withdraws the

spring lever and allows the lever to work. The shifting lever end is made with a joint, so that by simply withdrawing it from contact with the snail the tune is not changed, although the spring lever may be withdrawn by the pin in the barrel. The quarter barrel thus performs four distinct functions. It strikes the quarters, stops the machine when required by a simple action—which I have thought it needless to explain—causes the music to be played at the proper times, and changes the tune or not, as desired; thus making it an automatic machine, it only being necessary that a small weight should be lifted by the clock and allowed to fall at each quarter of an hour, by which the machinery is started for the quarters, and a similar weight each third hour for the music. In the one case, the weight is raised by four pins in a gun-metal wheel fixed to the minute square of the clock, and in the other, from the locking plate which regulates the striking of the hours. The improvements sought for in the construction of our next machine were these—to do away with the key-frame which we thought unnecessary, both on account of the expensiveness of its manufacture, and the drag we found it was upon the machinery. The discharge was not as easy as we could have wished it to be (although the machine still works admirably), and other minor details, such as to reduce the weight of the cam, to do away with the hammers having to drag the weight of the levers after them, and so reducing their force of blows; and in other respects to give the machinery more life, or more properly speaking, velocity, which performs a most important part in this machinery, the two main considerations being an easy and quick discharge, the most rapid lift attainable, so as to have as few hammers as possible on the lift at one time. The machine I am now about briefly to describe, has been made for, and is now in course of erection at, High Beech Church, Epping Forest, to the order of T. C. Baring, Esq. There are thirteen hemispherical

bells in a tower nine feet square, and the machinery is placed in a room below. In a space of only nine feet square it would have been quite impossible to have got church bells of any size or of a sufficient number, and ringers could not have been found to use them. Hemispherical bells here exactly supply the want, and in making the machinery we desired that it should be no mere approach to the speed of changes as rung by ringers, but the exact speed should be given.

Ringers ring 28 changes per minute, which is 224 blows in the same time, each change being 8 blows on 8 bells, and in order that not more than one hammer should be on the lift at once it was necessary to have a cam of that lifting power. The main wheel makes a revolution once a minute, consequently the discharging barrel which it drives from its shaft, as before described, makes a revolution in the same time; and to produce the needful correspondence between our wheels and pinions, and to give the proper interval between each pair of changes, exactly the same as ringers do, it was necessary to make our cam revolve 60 times to its once, and having four lifters, four times sixty (240) blows can be lifted per minute, more really than is required. I may here say that before making this machine we made a smaller one, which we here exhibit, and which we have had in use for some time. The heaviest hammers to be lifted are about 20 lbs., for which the machinery need not be large. For larger machines we have plans of a more powerful description, which we do not propose here to explain, suffice it to say that, be the weights what they may, we are prepared to deal satisfactorily with them. Having disposed of the number of hammers to be lifted, our next object was to do away with the unwieldy key-frame, and make a key and catch-all in one, which should be quite easy of discharge and yet have holding power to its extreme point of discharge. This was not arrived at without much thought, one amongst many difficulties

being to put them in such a position that the wooden barrel could be removed without disturbing them. This has been quite satisfactorily done, a catch has been constructed with all the requisite qualities in itself, and has been put in such a position that the barrel can be removed in a moment. We also here introduced a great improvement in the spring which draws in the pusher, by which the lever, to which is attached the bell hammer, is raised again to the catch which holds it. When the catch is discharged and the lever falls, it is of course necessary that the lever should not be again raised until the blow is struck upon the bell; and in order to do this, what we call a pusher, or cat's-paw is attached to the lever, working freely on it, which is drawn into contact with the cam at the last moment in this way. It is, of course, a well-known mechanical law that there is much less action at the centre upon which anything works than at its extreme end. We therefore place a spring on an iron bar, which does three things. While the lever and hammer are held up, it keeps the pusher against its banking pin; as the lever falls it keeps it pressed away from the cam till the last moment, when its bent end comes in contact with a corresponding projecting part at the centre of the pusher and so draws it in contact with the cam, the next coming lifter of which lifts it to the catch, firmly held by which, all the weight of the hammer being gone from it, it flirts the pusher away to the banking pin till again discharged, when the process is repeated. Originally three separate actions were provided for this purpose. We consider these two improvements to be of the most important character, both as regards cost and efficiency. Other improvements were made, but not of sufficient importance to be referred to. It has two barrels, one of which has 296 changes on eight bells pricked on it, which will be used from 10.30 to 10.45, at which time that barrel will be taken out and one with 110 changes on 10 bells, three

bell chimes and tolling, used at the discretion of the verger. A barrel can also be applied by which the hours and quarters can be struck the same as at Westminster; or, still further, a 7-tune barrel could be made, by which a different tune could be played through twice, at each hour, or the same at will, if the quarter-hour striking were found wearisome. To remove the barrel, all that is necessary is to move the spring which presses on the end pivot on one side, draw the barrel a little to the left, and out it comes free of everything. There is also a key-board attached, by which Mrs. Baring can play on the bells as easily as she can play on a piano. This machine, therefore, is applicable for four purposes, chiming for the services of the church at any time, the striking part of a Cambridge quarter-clock, the playing of seven different tunes automatically, or a musical instrument to be played by hand. Some of my fellow-craftsmen here this evening may perhaps be sceptical, and say that I have as strong an imagination as the man who used to warm his hands by holding them round a candle-flame, but I can assure them it is quite true, and that I may perhaps have some further astonishments in store.

All our machinery is so constructed that any one part can be taken out for repair without disturbing any other, and even to every lever, and every catch up to any number. The advantage of this plan was fully demonstrated in this way. After the machinery had been fixed at Ipswich some short time, I had left it at nine o'clock on the Saturday evening, after it had chimed the quarters and played its tune twice over, and upon my return, at nine o'clock on Sunday morning—of course you understand that I was only there to see all was right—to my great dismay I found that the heavy rain of the night before had run through an unstopped hole in the lead floor of the bell-chamber above, and that the machinery was most carefully watered all over. Of

course by Monday red rust was everywhere where I had not been able to wipe it off the day before. A workman and myself began at seven o'clock on Monday morning. It only missed striking the quarters for two hours; it played as usnal each third hour, and was as free from water and rust as ever it was by six o'clock the same evening, much of the steel work having been re-polished. Had it been needful to take all the machine to pieces at once, three days at least of silence would have been necessary.

It now only remains to explain the arrangements we have made in the larger of the two machines before you for the several actions it has to perform. It will chime the Cambridge quarters, and strike the hours (the same as the Westminster clock), and will play one of seven tunes every third hour, to be changed or not at will, as described in the others, with only one weight and one train of wheels. Clock-makers have always, hitherto, used three weights and three trains of wheels for the same purpose. It will also be used for chiming for the services of the church of St. Mark, Victoria-park. As you see there are two wooden barrels; one, the shorter, chimes the quarters and strikes the hours, and the longer will play the tunes or changes. The smaller barrel makes fifteen revolutions in twelve hours by means of a fifteen-step snail, which is shifted one step forward by a carrying-arm and double-action lever, once each turn, the same as used for altering the tunes, and before described. The quarters are also struck from it by means of keys and levers, connected with the four proper notes on the music side of the machine. By it are also struck the hours by a key and lever action, drawing in the hour-hammer lever in contact with the pins in the back of the main wheel of the machine, and holding it there sufficiently long for one or more blows to be struck on the bell, according to the hour. Immediately the last blow is struck, the spring, against which it was drawn, throws the

lever out of the way of the pins, and at each third hour a weight is dropped, and the musical barrel pushed in, it having stood still during the striking of the hours and quarters, as already described in the Ipswich machine. We have, however, greatly improved and strengthened the catch which holds up the lever to which the weight is attached, and have made the lever to fall free of the lifting pins in the face of the main wheel, so that by removing the jointed end of the snail-shifting lever, and moving forward the small-barrel snail to a step in which there are no pins, as occurs in that part of it which comes into action each third hour, changes or music can be played for any desired length of time, without the weight being raised, and the barrel being pushed out of action, after the second time round, as it would be in the ordinary way. In the Ipswich machine the shorter wooden barrel is a three hour locking plate for hours and music only; in this it becomes a twelve hour rapidly revolving locking plate, for hours, quarters, and music, than which there is no simpler or safer mode of stopping in clock work or any self-acting machinery. A slow one is, however, of very little use. In the intervals defined by this locking plate pins will be put which will either act upon the four quarter keys, the hour lever key, or the key which discharges the weight for the playing of the music, and causes it to be raised again when it should cease, one key serving both purposes, according to whether quarters or hours are to be struck or music played.

We are also engaged upon the manufacture of a smaller machine for ten small hemispherical bells, the stable turret into which they will go being only 4 ft. 6 in. square by 8 ft. high, which, with change of barrel, will either strike the hours and quarters, or play one of seven tunes twice over every hour, or as often as desired; a key-board for playing by hand will also be added. We are also planning a Cambridge quarter clock, which will

only require one weight instead of the two ordinarily used, for a larger tower, hemispherical bells again carrying off the palm. The advantages which we claim for our method of carrying out this patent are:—Extreme simplicity of all the parts of action; lightness of all the several parts, yet perfect strength and durability; high finish and accuracy (and upon this point we are most particular, as, failing this, in self-acting musical instruments all else is labour in vain); absolute steadiness and ease of discharge, by which perfection is obtained in the music or changes, or whatever work the machinery is called upon to perform; rapidity of lift, by which multiplicity of hammers is avoided and weight saved; ease with which repair can be done to any one given part without disturbing the machine as a whole; and last, but not least, cheapness, not the cheapness which is obtained by inferiority of workmanship, but cheapness which is obtained by simplicity of action—not using three actions where one will do because our ancestors did it that way three hundred years ago, and therefore it must be right, and, consequently, saving material and labour which which make the cost.

After a short discussion the Chairman said it became his duty to ask those present to join him in a vote of thanks to Mr. Lund for the very interesting paper he had read. He thought it would be apparent to all that it had been a labour of love to him, and that he had brought to the subject a great amount of patient labour, attention, and scientific skill. As to the last paragraph, they must have all felt the soothing influence produced by a chime of bells, and many were the sweet recollections the village bells recalled to most of us. He agreed with the speaker who remarked that some bells in London were felt to be a nuisance, but even in London many people liked to hear a chime of bells. As to young beginners, he thought they would be deterred from commencing the study of change-ringing by the description

of Mr. Lund. He would say, even if he had an inclination at his time of life to commence a new study, what had been stated was more than sufficient to deter him, and he would rather prefer commencing the study of Hebrew or Sanscrit. He asked them to join with him in sincerely thanking Mr. Lund for his paper, and in congratulating him, after the years of labour he had bestowed, on the satisfactory results he had produced. He could only express a hope that those labours and the intelligence he had shown might not cease, but that they might be devoted to some other work in the same branch, which might tend to be useful to both science and art.

Mr. Lund in reply said :—I rise to thank you, Ladies and Gentlemen, for the kind way in which you received my paper. I can assure you it has been a very great pleasure to me to come here and read it.

The vote of thanks was then passed.

A short Description of the Patent Machinery manufactured by Messrs. LUND & BLOCKLEY, and the advantages claimed for it.

FIRST as it relates to Clocks which chime the quarters and strike the hours.

For such Clocks Clockmakers have always hitherto used three weights and three trains of wheels, all included in one frame, by which all the vibration of the striking is felt by the going part, which is *decidedly objectionable.* Under the patent they put the going part in a frame by itself, and all the work it has to do is to move the hands on one or more dials and lift and let fall a small weight every quarter of an hour to set the machinery in motion, which chimes the quarters and strikes the hours, and which stands by itself and with one weight only does the work of Clockmakers' two weights and two trains of wheels. Under the patent as carried out by LUND & BLOCKLEY, the discharge of the hammers upon the bells being very easy and the relifting very rapid, the precision of time of the quarters is perfect and under no other plan can changes be given on six or eight bells.

Summarized the advantages are :—

1st. The striking is no interference with the time-keeping of the Clock—*most important.*

2nd. One weight and one train of wheels only is required for the chiming of the quarters and striking of the hours instead of two.

3rd. Regularity of interval between each blow much more exact and will always remain so, the discharge being very easy and entirely independent of the lift of the hammer.

4th. Saving of cost.

Now with reference to Clocks which, besides chiming the quarters and striking the hours, play tunes every third hour or as often as desired. All the above advantages are gained in these Clocks as in the others, and, in addition, the tunes which are played do not involve the use of a fourth weight and train of wheels. Some slight addition only is made in the hour-and-quarter barrel; and a barrel of seven tunes, by most simple mechanism is made to work in connection with it each third hour or as often as desired, by which a different tune of the seven can be played over twice, or the same at will.

Any number of barrels of seven tunes can be added at any time, and a barrel can also be made to it, so that changes such as ringers ring can be chimed upon the bells. This, in the case of a Church, is used for the services, and at a Town Hall or other building would be used on any public rejoicing, or with the object of showing off the bells to the best advantage. Upon no other machinery but theirs can this be done.

In this part of the machine, also, the discharge of the hammers is made perfectly easy and independent of the lift, which is again very rapid, to insure the tunes being played in a lively way and in correct time. A key board is also applied by which tunes can be played by hand with the greatest ease.

Summarized, the advantages are the four already enumerated under the head of Chiming Clocks.

5th. With the addition of one or more barrels and the needful hammers and hammer works for the extra bells, one of seven or more tunes can be played twice over every third hour or oftener, the same or a different one each time at will.

6th. Ringers changes can be rung at full speed, and with the greatest precision, by the addition of another barrel, for the services of a Church, or on public occasions at a Town Hall or other public building, or the better to show off the bells.

7th. A key board can be added for playing tunes by hand.

Messrs. LUND & BLOCKLEY have made, under the patent, a machine to chime the quarters, and play a tune every third hour, with 16 bells, for Orwell Park, Ipswich. One for High Beech Church, near Loughton, with 13 bells, which has two barrels, one for 196 changes on eight bells, and one for changes on 10 bells, rounds on three, and tolling on the tenor for the services of the Church. A key board is attached by which tunes are played by the organist on the 13 bells. Another is about to be added, which will then make the machinery the striking part of a quarter Clock. Another they have made, by command of the Queen, for St. Mark's, Victoria Park, which combines in itself all three things. It chimes the quarters, strikes the hours, and plays one of seven tunes twice over each third hour, with one weight and one train of wheels, and is the only one existing of its kind. All these bells are hemispherical.

They are now making, amongst others, one on the same principle for a peal of eight large church bells, for a Church at Derby, the tenor bell of which will weigh one and a half tons.

They have also just completed, at a Church at Weymouth, a machine with two barrels for the services

of the Church, and an extra barrel of seven tunes, one of which is played over twice each third hour, and a key-board is attached for playing by hand. There are ten hemispherical bells, nine consecutive and one half-note.

The generous gift of a peal of bells, by Henry Edwards, Esq., to Weymouth, consists of 10 hemispherical bells cast by Messrs. Taylor & Co. of Loughborough, to whom the greatest credit is due for the trouble they have taken to cast so musical a peal in the short time Messrs. Lund and Blockley were able to give them from the receipt of the order to the end of the year, being less than three months. The term hemispherical must not be understood in its literal sense. They are not, actually, half spheres, but resemble, as much as possible, the old-fashioned finger glasses, from which, when struck on the edge, a beautiful note may be produced; and, in using them in certain cases, the advantages claimed for them are the very great saving in the weight of metal necessary to produce a given note in the musical scale; and, consequently, the perfect safety with which they can be put in towers with weak foundations. Take the instance of our own peal of ten. The tenor bell weighs about five cwt., and is B flat; to produce the same note in the church-bell shape would require twenty cwt. of metal; of course the five cwt. will not produce the same volume of sound as twenty cwt., but the relative sweetness and quality of tone of a hemispherical bell of five cwt. over a church bell of the same weight is very greatly in favour of the former; and Mr. Taylor, who has cast some of the largest and most successful bells in the country, speaking of peals of hemispherical and church bells with that weight of tenor, viz., five cwt., says that the church bells should not, on any account, be recommended of so light a weight. The first large peal of hemispherical bells, put up in this or any country, were made to the order of Messrs. Lund

and Blockley by a London firm for Orwell Park, Ipswich, and were 16 in number, tenor bell E flat and weighing about six cwt., since which, they have supplied peals, amongst others, of 13 to High Beech in Essex, of 11 to St. Mark's Church, Victoria Park, London, by gracious command of Her Majesty the Queen, in commemoration of her visit to the park; and, in every case, they have given universal satisfaction. No attempt was made in any case, nor was it intended, at Christ Church, to make a great deal of noise to be a nuisance to everyone; but what was intended, and has been done, is to put there a peal of most musical bells which can be heard, with pleasure, by everyone within a radius of two miles with the wind in any direction, save the immediate neighbourhood of the tower and esplanade. It is much to be regretted that this should be so, but it is no fault whatever of the bells, but of the tower which, on the seaward and town side, is completely blocked in by houses, as everyone can see for himself, and what obstructs the sight, must of necessity, prevent the sound from reaching the ear. Many people have heard them at the cemetery, Radapole Church, and all round to the Dorchester Road for two miles; and, in some cases, farther. They have been heard, with the wind blowing strongly in an opposite direction, on the Dyke Road, and it will be found that in walking along the esplanade, where the sound can force itself through there, the bells are to be heard; and from St. John's Church, a fine position for another peal, they can be distinctly heard as far and farther than the coast-guard station. They are in the key of B flat; nine consecutive notes, and a flat seventh. The bells are contained in a wooden frame nine feet high by about five feet broad. Each bell is secured to its beam by a bolt and screw passing through a hole in its centre. There are two hammers to each bell attached to the beam above with a counter-spring to each to prevent double blows. Another frame carries

a pair of cranks for each bell, which are attached by wire each to its proper hammer, and thence communicate, by similar wire, to the levers in the machinery below.

The machinery made by Messrs. Lund and Blockley of 42, Pall Mall, London, watch and clock makers to the Queen, is constructed under a patent which was the invention of Mr. Imhof of 547, Oxford Street. He originally used it for the drum-beaters in his self-acting organs, of which he is the sole manufacturer in London, and it occurred to him that the same idea would answer for the hammers to strike on bells in chiming machinery. The fundamental principle of the invention is this, that the discharge of the hammer should be independent of the lift. In old chiming machinery this is not so. It will there be found to be done by pins in a barrel of large and ponderous construction, which, in revolving, lift the levers to which the hammers are attached, and let them drop again as soon as their lines of contact are passed. In the patent the hammers are lifted and held by catches till pins, in a barrel of small and very light construction, pass and release them much in the same way that a gun is full-cocked by the thumb, and easily discharged by the first finger. The important points to be considered in making the machinery are, to have a very easy discharge and rapid lift, in order to avoid multiplicity of hammers to each bell. This Messrs. Lund and Blockley have most satisfactorily accomplished. It will be found that an amount of pressure can actually be applied to the levers sufficient to break them before they will pass; but touch the catch in the proper place and they will pass with the greatest ease. The lift is also very rapid, as many as 224 blows being discharged and lifted per minute, so that two hammers only are required to give the most rapid repetition on each note or bell which music can want. The motive power is a weight attached to a drum and main wheel,

intermediate wheel to drive the cam and a worm wheel, and worm with fans to regulate the speed. Upon the main wheel arbor of the machine, one of the three barrels belonging to the machine, and hereafter to be described, is placed in such a way that it can be easily removed. This barrel when the machinery is started moves round, and by means of pins in its surface discharges the catches, the levers fall, and the required blows are struck upon the bells. By means of a simple spring action a loose pusher is brought in contact with the cam, and the lever is raised again to the catch and there held till again wanted to be discharged. The barrels are made of wood, they are 10 inches diameter and about 26 inches long; and in them are placed the discharging pins as before described at the proper intervals to produce given tunes or changes. The pins are made of brass; and, for the heaviest hammers, would not exceed one-eighth of an inch in diameter, any pressure of hammer on the catch which these could not discharge being destructive of all proper time-keeping; and it will be readily understood that this is a most important point in the machinery, when it is stated that in two barrels which are used for chiming the changes for the services of the church the actual interval of time elapsing between each blow delivered is about a quarter of a second, and the actual space occupied on the circumference of the barrel one-eighth of an inch. The barrel makes a revolution once in a minute, ringers ring 28 changes in the same time; and as the machine is not an attempt only to produce changes at full speed, but that it positively does it; and as there are eight blows in each change, it is seen that 224 blows are discharged and lifted again in each minute. The barrel being 30 inches in circumference, multiply 30 by 8 which will give 240 against 224 blows struck. The 60 seconds in a minute, multiplied by 4, again gives 240 against 224 blows struck. These facts taken into consideration, the

precision of the change-chiming seems marvellous. In the third barrel for the seven tunes, the intervals are of course greater, but it will be found that the time kept is most perfect, so much so, that if part of a tune be heard at a distance, and the wind then fails to carry the sound for a bar or two if the tune be hummed in proper time, as soon as the sound is heard again, the note will be found to be the one required exactly. The tunes are—

1. God save the Queen.
2. Auld Lang Syne.
3. Adeste Fideles.
4. Blue Bells of Scotland.
5. Rule Britannia.
6. Old 100th Psalm.
7. Home, Sweet Home.

and it will be found that each tune is given with the greatest exactness; and is, in no degree, mutilated as is often the case in chiming machinery of other kinds to meet the difficulty of lifting the hammers, in rapidly recurring notes upon the same bell. The rapid and florid passages of the quick tunes being given with as perfect accuracy as the slower time of the sacred tunes. One tune will be played twice over each third hour when the clock is completed, the same or a different one each third hour at will by simply laying a lever up or down. The whole machine is so arranged that each part is easily accessible without disturbing any other, and of the best materials and construction. There are many other points worthy of notice in connection with the machine, notably, a key board, by which tunes can be played by hand with the greatest ease, but the principal points have been referred to. Mr. Churchwarden Rowe has charge of it, and will, no doubt, afford every facility for its inspection. Mr. Butt has been entrusted with the winding up and general care of the work.

The cost of the machinery has been provided for by the proceeds of a bazaar got up by the ladies of Weymouth, and we hope it will prove a source of pleasure to them for many years to come.—"Weymouth and Portland Telegraph," January, 1875.

A new Carillon Machine, of exquisite and ingenious workmanship, has lately been set up at Christ Church, Weymouth, by Messrs. Lund and Blockley of 42, Pall Mall, London. The bells are not of the usual form for ringing, but are fixed hemispheres, called by the ancients *Petasi*, or Skull-caps, like that worn by Mercury. They are from the foundry of Messrs. Taylor of Loughborough, in B flat. They are the gift of Henry Edwards, Esq., M.P.; the cost of the machinery being paid for by a bazaar and subscription. For a detailed description of the machinery we beg to refer our readers to a most interesting paper read by Mr. Lund, in March last, before the Society of Arts, which is published in the "Transactions" of that Society.—"Church Bells," February 20, 1875.

Fargues & Co., Printers, Warwick Street, Regent Street.