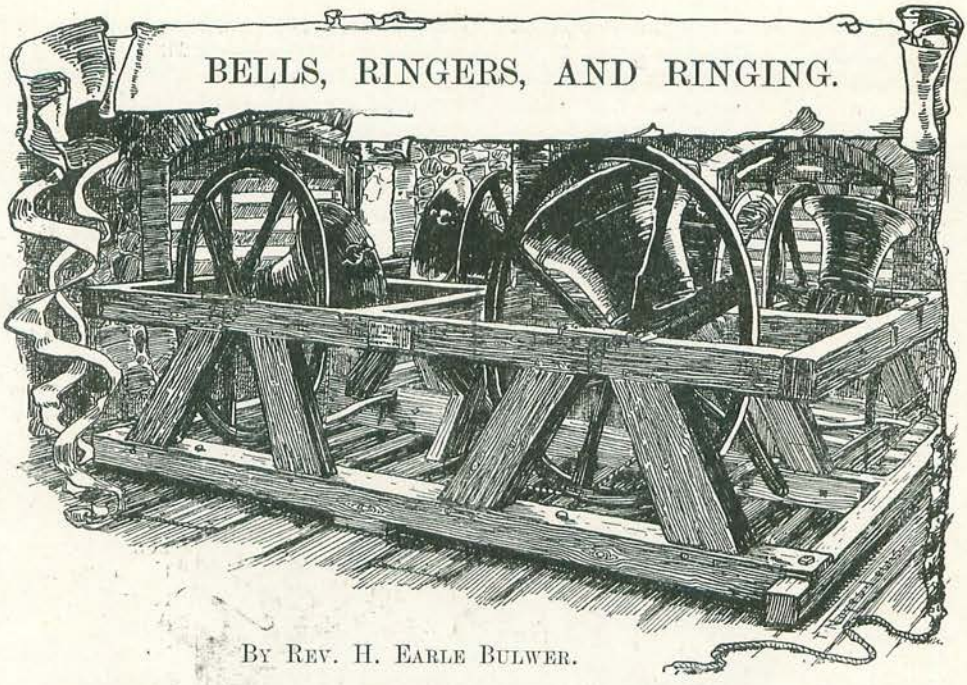
BELLS, RINGERS, AND RINGING.



By Rev. H. Earle Bulwer.

Illustrated by T. Noyes Lewis; *and from Photographs.*

OUTSIDE the ranks of ringers themselves a general ignorance seems to prevail of the whole subject included under the above title. Yet the general reader may approach the matter with every prospect of finding interest in it when divested of technicalities. To awaken that interest it should be sufficient to say that the art of scientific change-ringing is one exclusively English, and singularly fascinating to all who practise it. Treated usually as an unintelligible mystery, writers on other branches of bell lore are accustomed to dismiss change-ringing with a few contemptuous ill-tempered phrases as a noisy nuisance; while strangers to the art, watching skilled ringers practising, invariably confess that they can make nothing of it. Some attempt to elucidate the subject should not, therefore, be wholly unwelcome.

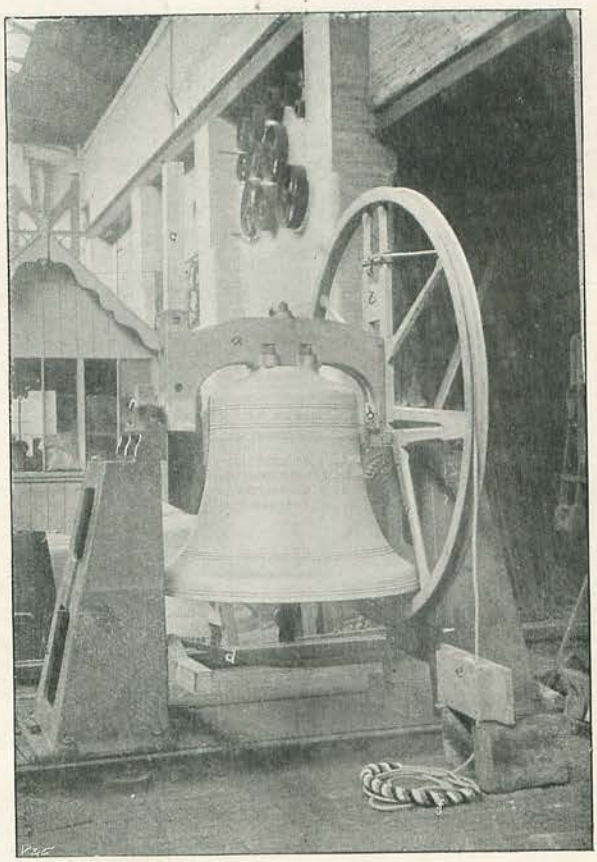
The late Mrs. Glasse, in her cookery book, prefaced a recipe for jugged hare with the sage advice, "first catch your hare," and with ever-increasing wisdom added, "then skin him"; and since, before anyone can ring a bell, he must have a bell to ring, and that bell must be properly hung for ringing, I also would say, first cast your bell, then hang her. (Don't quarrel with the pronoun, please; for although you may have your Great Tom, and your Great Paul, and your Big Ben, it is customary to regard them all as *shes*—like ships.)

Now the process of moulding and casting a church bell is one of considerable delicacy, requiring great skill and experience. The excellence of a bell as a musical instrument will depend upon the adoption of proper proportions in designing, accuracy in moulding, and care in mixing, melting and running the metal. The true principles to be observed in designing a bell are better understood now than in the days of the old founders, who probably worked more by rule of thumb than by any scientific system of calculation; hence their productions were frequently bad or indifferent, with only a few really good; for a good design would, more often than not, be marred by careless or faulty moulding, their methods and

implements being of a rougher sort than would be tolerated in a modern foundry.

The curves for the inner and outer contour of the bell having been calculated and traced, are reproduced in sheet metal for attachment to a light iron frame of special construction, which has superseded the clumsy wooden boards generally used. This iron frame, with its interchangeable metal templates, is called the "sweep," and on its accurate adjustment the correct proportions of the bell to be cast will depend.

Formerly it was usual to build up the mould in three parts, called respectively the "core," the "thickness," and the "cope"; modern improvements however have abolished the thickness, thus saving a great deal of time and trouble in the process. The core is first built up on a cast-iron plate as a foundation; it consists of a hollow cone of brickwork, plastered over with suitable clay mixture, the last coat of which is carefully fashioned to the inside contour of the bell by means of the inner template on the sweep, which is mounted on an axis truly centred above and below the core. The modern development, which has superseded the old plan of a moulded thickness over the core, takes the form of a cast-iron cope-case, which is adjusted level in an inverted position, and with as much concentric precision as possible, over the lower centre of the sweep axis. Clay mixture is then plastered over its inside surface till a thickness of some inches is obtained. A last special coat is then applied, fashioned with the outer sweep, and worked up to a perfectly smooth, firm and uniform surface. The ornaments and inscription are impressed upon the finished surface by metal dies and stamps. It is essential that every part of the mould should be thoroughly dry before casting takes place, the drying being effected gradually as the moulding proceeds; or it may be hastened and finally completed by the employment of a hot-air chamber.



A BELL HUNG TEMPORARILY ON SUPPORTS IN LIEU OF FRAME, TO SHOW WORKING PARTS.

a. cast-iron stock; *b*. wheel; *c*. stay; *d*. slider; *e*. guide pulley and box; *f*. sallie of coloured wools woven into end of rope; *g*. end of steel gudgeon.

The crown piece to contain the cannons (when such are required for the attachment of the bell to its stock) is moulded separately, a circular and central bed being formed in the cope for its reception. The cope in its case, when finished, is placed over the core with the utmost attainable exactitude to ensure a concentric position, the two parts being clamped firmly together. Here again, as well as in the adjustment of the sweeps, there is risk of error, which may be fatal to the prospect of producing a good bell. For although guiding flanges are moulded with both cope and core, a little dust or débris of plaster under the edge of the cope may cause a serious derangement in its position. Careful gauging, therefore, is employed to ensure equality of distance on all sides between the two parts of the mould. It is obvious that if the cope is not exactly concentric with the core, one side of the bell, when cast, will be thicker than the other, and the bell will be "out of tune with itself," and it will proclaim the fact by the beating or throbbing quality of its sound, with which everyone

is familiar, so frequent is it, especially in old bells.

It will be as well to explain this more in detail. The vibrating portions of the sound bow of a bell are four in number, separated from each other by four equidistant quiescent points, called the "nodes." Now if one of these vibrating quarters is thicker than the opposite one, it will produce more vibrations per second, i.e., it will sound a higher note, or, in other words, the sound-waves that proceed from it will be shorter than those coming from the thinner quarter. These two sets of waves, therefore, will only synchronise at stated intervals, imparting a momentary fulness to the volume of sound, which dies away again till another interval of discrepancy has been passed, thus producing upon the ear the sensation of a succession of beats or throbs, more or less rapid according to the difference in length of the two sets of sound-waves.

The actual process of casting is a comparatively simple affair. Copper and tin are the only metals employed, in the proportion of four to five of the former to one of the latter, the best brands being now used, though not so many years ago (as appears from an article in the *Penny Magazine* for March 1842) any scraps of ship-sheathing, old kettles and the like were thought good enough. Tin is more volatile than copper and melts at a lower temperature; it is not therefore put into the furnace till the copper is melted, sufficient time only being allowed before tapping the furnace to admit of a thorough admixture of the metals. Different methods of running the metal into the moulds are practised, the old and more common plan still being to sink the moulds in a pit, covering them up with loam, and conducting channels over the surface of the loam from the outlet of the furnace to the orifice left in the top of each mould for the admission of the metal. When cope-cases are used it is not necessary to sink the moulds at all, the metal being conveyed from the furnace in a ladle by the travelling crane.

The old founders, it is well known, would often travel from place to place where bells were wanted and conduct their moulding and casting operations on the spot, rigging up a rough shed or shelter in a corner of the churchyard or in some neighbouring field and melting their metals as best they might in a roughly-constructed furnace. It is a tradition that on such occasions contributions of silver were frequently offered by the wealthy towards the composition of the church bells. One does not like to regard this wholly as a fable, but it is certain that analysis of old bell-metal has not so far yielded any trace of silver, and one can only suppose that, if the devout lord or lady of the manor gave of the family forks and spoons for this purpose, they must have found their way into some receptacle other than the melting-pot.

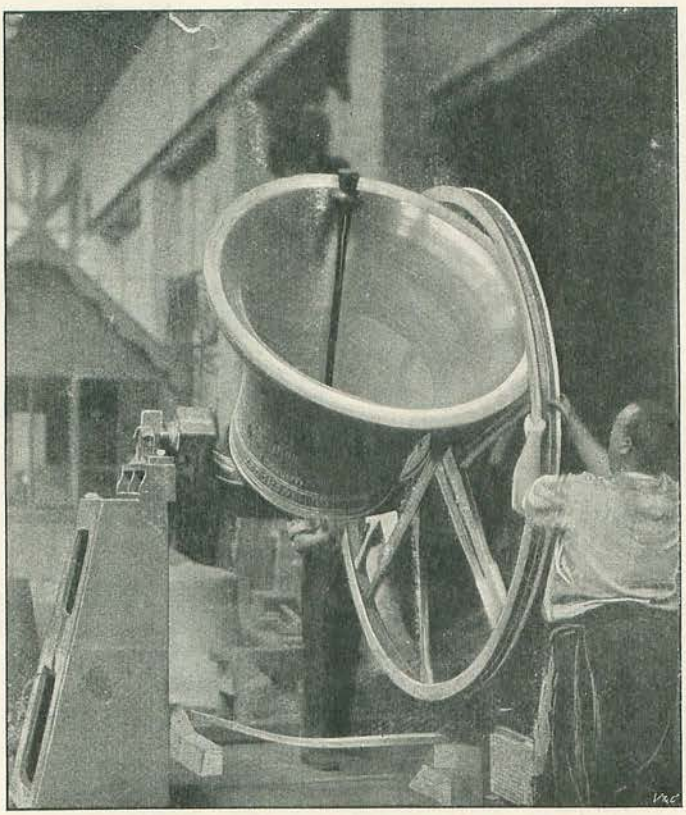
It will be clear now that if church bells are wanted it will not do to give the order to any local brassfounder, however willing he may be to undertake it. An enterprising ironfounder once offered to cast a bell for me on advantageous terms. It was to be of the metal with which he was most familiar! The proposal was meant to be a tempting one, but I did not accept it.

It rarely happens that a bell issues from the mould possessed of exactly the musical pitch expected of it. The operation of tuning then becomes necessary. In common with other musical instruments a bell will always emit a composite sound, consisting of the fundamental, or key-note, and several overtones, as they are called. A good bell should possess among these overtones the third, fifth and octave above the fundamental, that is to say, it should sound the notes of the common chord in true relation to each other; and there is also the "hum-note," an octave below the fundamental. But these overtones are seldom found in true relation to each other, or to the fundamental; the tone of the bell consequently suffers in point of quality. How to bring these erring overtones into correct relationship is the tuning problem of to-day, towards the solution of which some recent investigations and experiments have made hopeful advance.

During a visit to Messrs. Taylor & Son's foundry at Loughborough lately, I was most courteously afforded an opportunity of observing the latest developments in bell-tuning, and in what I saw I gladly recognised a dawning prospect of getting church bells tuned on true scientific principles and with superior results. Messrs. Taylor have recently erected a very fine tuning machine in the shape of a vertical lathe. The bell which is to be tuned is clamped to the face-plate and revolves against a cutter-bar fixed to the slide-rest saddle; any part of the inside of the bell can thus be reduced as required. English founders have hitherto, as a rule, confined themselves to the correction of the fundamental notes of a ring of bells, leaving the overtones to take care of themselves. And since it is easier and less

prejudicial to the bell to flatten than to sharpen it, it is usual to take the flattest bell of a ring as the standard and tune the rest to it.

The principles of tuning are briefly these: if the sound is too sharp, showing that the vibrations per second are too numerous, the substance of the vibrating body is reduced in the direction of its thickness; if the sound is flat, showing the vibrations to be too few, the substance is reduced in the direction of its length, it being impossible to add to the thickness. To flatten a bell, therefore, the tuner cuts off a sufficient amount of metal uniformly all round the inside sweep of the sound-bow. To sharpen it (a process to be by all means avoided if possible) he removes a portion of the metal from the lip of the bell externally and uniformly all round the circumference. Tuning, however, should not be attempted by the inexperienced; indeed, whenever it has to be done it is better to send the bell to a foundry where it can be treated by the modern tuning machine. The common and inferior plan is to chip away the metal with a hard chisel and finish with the file. Fifty years ago a rougher method appears to have been in vogue, if one may judge by the article in the *Penny Magazine* already quoted, in which, speaking of tuning, the writer says: "This reduction is made by chipping away the metal with a sharp-pointed hammer!" And truly many bells present sad evidence in their hacked and hewn appearance of the ill-treatment they have suffered under the name of tuning. To illustrate the risks which attend the inexperienced tuner I may relate a story told some years ago of an individual, who shall be nameless, obtaining permission to tune a bell which needed it. The bell was too sharp, so he set to work with chisel and hammer and removed a goodly slice of the thickness from inside. On testing the tone it was found that his zeal had outstripped his discretion, and that the bell was now a good bit too flat. So he set to work again and chipped away the lip of the bell. Alas! it was now too sharp again. Nothing daunted, our hero of the chisel hacked away again manfully at the inside curve, only to find that he had yet again done too much, and the poor bell could only emit a feeble sound flatter than before. Another slice from the lip left it a wreck only fit to be pitched out of the bell-chamber window!



A BELL BEING TESTED IN TEMPORARY SUPPORTS.

From an instantaneous photograph taken at the moment of the clapper's impact, by Mr. J. W. Taylor, jun. The bright surface left by the operation of tuning is here well shown.

For ringing in the orthodox manner, bells must be specially fitted and hung in a rigid framework, which is constructed usually of oak, but preferably of iron or steel, on strong beams or girders. On the excellence of the hanging depends the easy action of the bell and much of the pleasure of ringing. Bell-hanging is a separate branch of trade, and none should be employed to hang bells

but workmen experienced in it. The question is often asked, "Is not bell-ringing very hard work?" The answer is, it depends entirely on the condition of the fittings and frame, and the way in which the bells have been hung. The wood is well-seasoned oak, and a good many of the finest frames have come from Sussex. It is often harder work to ring a treble bell of 5 or 6 cwt. for half-an-hour, when badly hung in a crazy frame, than it is to ring a tenor of 2 tons weight for three hours when well hung in a rigid frame. It is impossible for even a strong man to ring some bells for any length of time, while others of greater weight might be rung by a child. Not long ago the treble of a ring of eight was rung successfully through a peal of 5040 changes by a young girl of fifteen. And there have been two occasions when eight men have rung uninterruptedly for over ten hours to accomplish a peal of nearly 17,000 changes. Bell-ringing therefore, under proper conditions, demands skill and a certain amount of staying power rather than physical strength.

The action of a bell when "rung up" consists in a complete revolution on its pivots or gudgeons, first in one direction then in the other, the swing being arrested at the summit of the circle by a sliding bar provided with stops, against which a stay attached to the stock of the bell impinges. A well-hung bell can perform this revolution by its own weight, and requires no pulling, the exertions of the ringer being confined to the few pounds weight alone necessary to control the bell at the end of each revolution. A large grooved wheel of special construction, fixed to the stock, carries the rope so arranged as to be wound upon about three-fourths of the wheel at one revolution, unwound and partially re-wound in the opposite direction at the next. Once off the balance in the direction of its swing, no power of the ringer can control the bell; he therefore allows the rope, after drawing the bell off, to pass freely up or down, resuming his grasp as the motion of the bell slackens at the end of the revolution. Here he learns by practice to "feel the bell on to the balance," and can check it, or allow it to draw a little, as may be required.

Our forefathers began the practice of placing bells in the highest section of the tower, and constructed large open windows on each side to allow free egress to the sound. But it was found necessary to keep out the weather, hence the adoption of the familiar louvre frames, which effectually prevented the free escape of the sound waves, the sloping louvre boards deflecting them downwards to the ground immediately surrounding the tower. Consequently we often hear very bitter complaints nowadays about the noise of bells. Our forefathers belonged to a more robust generation, and seem to have rather enjoyed a good healthy noise. We, I suppose, are more sensitive; and because the bells appear to some of us mere noisy nuisances, must clamour for the suppression of ringing altogether, without stopping to inquire into the possibility of less violent and selfish remedies. If our forefathers had been wise enough they would have placed the bells at a lower level, and kept the sound windows as high above them as possible, there would then have been no complaints, or very few. As matters stand however, if noise is complained of, the sound windows should be built up *inside* with substantial brickwork to a height well above the upturned bells, leaving only the few openings quite at the top of the windows for the sound to escape by. The sound will then take its natural course, travelling away through the upper air, ascending rather than descending, the bells will be heard at a greater distance, and the sensation of noisy clangour near by will be obviated. The brickwork stopping is not visible from outside, so there is no interference with architectural effect. Reversible louvres, after the fashion of venetian blinds, are also effectual in modifying the noise of bells. Instead of attempting to deprive ringers of the means of practising the art to which they are devoted, and which constitutes an otherwise harmless, healthy, and intellectual pursuit, it would surely be better to urge church authorities to adopt one or other of these remedies.

Although we have the bells themselves of all ages, from the thirteenth century downward, in our churches throughout the country, giving token of the antiquity of ringing in the English style, as distinguished from chiming, yet we have but few records, and these meagre, of what manner of men they were who handled the ropes previous to the middle of the seventeenth century. The history of ringing during the past 200 years is more ample, and from it we derive most of the information we possess concerning the ringers of other days. That many of them were of a type that would hardly pass muster to-day is more than probable; and it is certain that until quite recent times many abuses and objectionable practices disfigured

belfry meetings and tended to bring bell-ringing into disrepute. Still it would be a mistake and an injustice to assume that all ringers were alike in these earlier days. There were some at least against whom no reproach could be levelled, and the records prove that there have always been—at any rate for the last 150 years or more—gentlemen amateurs among the best ringers taking a leading part in developing the science of campanology. Within the past thirty years the old belfry abuses have been corrected almost everywhere. Nearly every county and diocese has its society of ringers, whose watchword has been from the first, "Belfry Reform," and that Reform has been for the most part successfully accomplished. Only where the influence of the society has not penetrated, or is defied, can the vestiges of the old evils be found. Ringers are now, for the most part, a highly respectable body of men, mindful of their responsibilities.

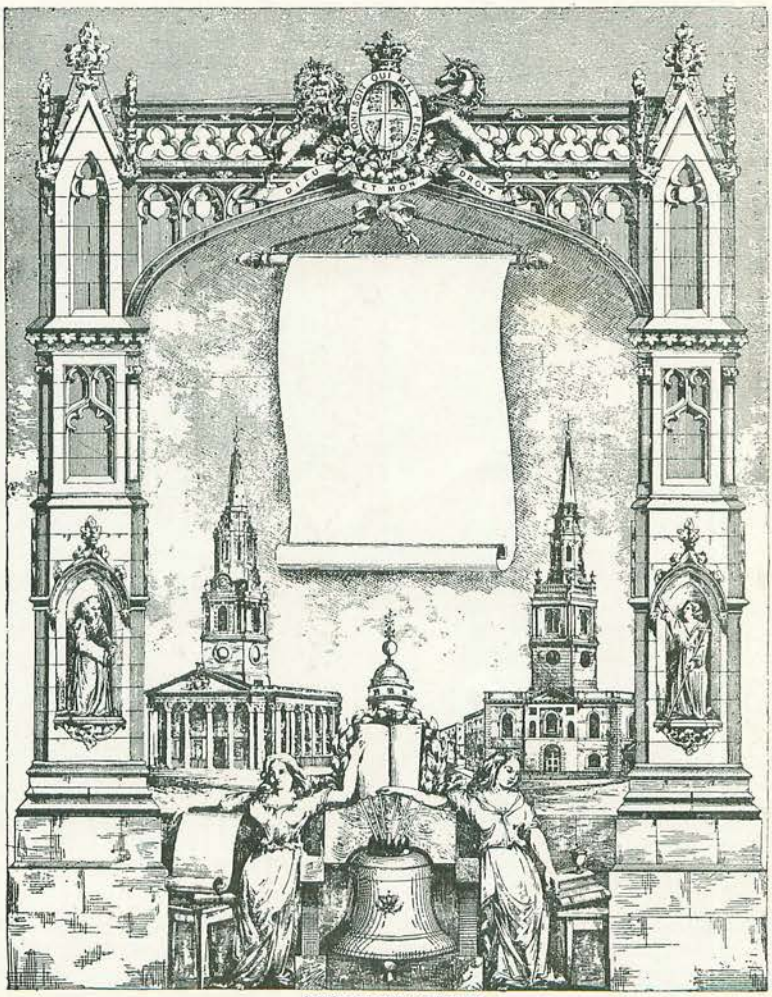
For the mere prosecution of the art of change-ringing societies have existed for nearly 300 years. The earliest metropolitan society appears to have been the "Scholars of Cheapside," founded in 1603, according to the late Rev. H. T. Ellacombe. The "Ancient Society of College Youths" succeeded it in 1637. Among those who founded it were Lord Brereton and Sir Cliffe Clifton. They used to practise on the six bells at St. Martin's, College Hill, whence the name "College Youths." It was to this society that Fabian Stedman in 1667 dedicated the earliest known book on change-ringing, and he also presented to them at Cambridge, where he lived, the sketch of his famous system of changes, known ever since as "Stedman's Principle," and to this day unsurpassed for beauty and ingenuity of construction.

Side by side with the College Youths there soon sprang up other societies. The "London Scholars," who afterwards, out of compliment to a certain victorious Royal Duke, changed their title to the "Royal Cumberland Youths," came into existence at the beginning of the eighteenth century, and were followed a few years later—about 1715—by the "Union Scholars," which society had a brief but glorious existence of about forty years. The College and Cumberland Youths are the two chief London societies at the present day, and between them they number in their ranks almost all the leading ringers in the country; but the first-named has by far the longest list of members.

Utter ignorance of the principles of scientific change-ringing has not hindered either scribes or artists from occasionally airing their ideas about it; the most ridiculous blunders have accordingly been sometimes palmed off upon an unsuspecting public as true presentations of the subject. I remember some years ago a picture appearing in the Christmas number of one of the illustrated papers, which was entitled "Ringing for Christmas," at one of the city churches—I forget which. This picture was truly a fearful and wonderful production. A ringer never lets go his hold of the extreme end of the rope while ringing, and controls its movement so that it shall rise and fall in a straight vertical path, otherwise he could not ring his bell in with others at all. But in this picture the dozen bell-ropes were flying all over the place; some snaking about on the floor, some twirling and twisting in the air to the imminent hazard of the necks of the operators. Not a single ringer was represented with a rope-end in his hand! Some were clinging frantically to the "sallies" or tufts, others crouched with arms and legs spread out, having apparently just flung away their ropes to go where they might. The serpentine contortions of the ropes and the agonistic attitudes of the men combined to make a lively scene; but it was all pure imagination, without a touch of realism about it. And some writers, devoid of the requisite knowledge, have not done much better. Let me endeavour to present something more reliable.

The art of scientific change-ringing does not seem to have been evolved before the beginning of the seventeenth century, the earliest systems in vogue being of the feeblest character, only a single pair of bells changing places at a time. About the year 1630 however the production of the first regular system for giving the full number of changes on five bells, to which its unknown author gave the name of "Grandsire Bob" (goodness knows why), paved the way for the rapid development of other systems. By 1667 Fabian Stedman had devised and sent out the very fine system for an odd number of bells which bears his name. Originally designed for five bells, it was speedily extended to seven, nine, and eleven, the nature of the system being such that this could readily be done without in any way disturbing the essential features of the method. There are now four or five main systems for producing the changes on any number of bells from five to twelve inclusive. The nature of the path pursued by the treble bell

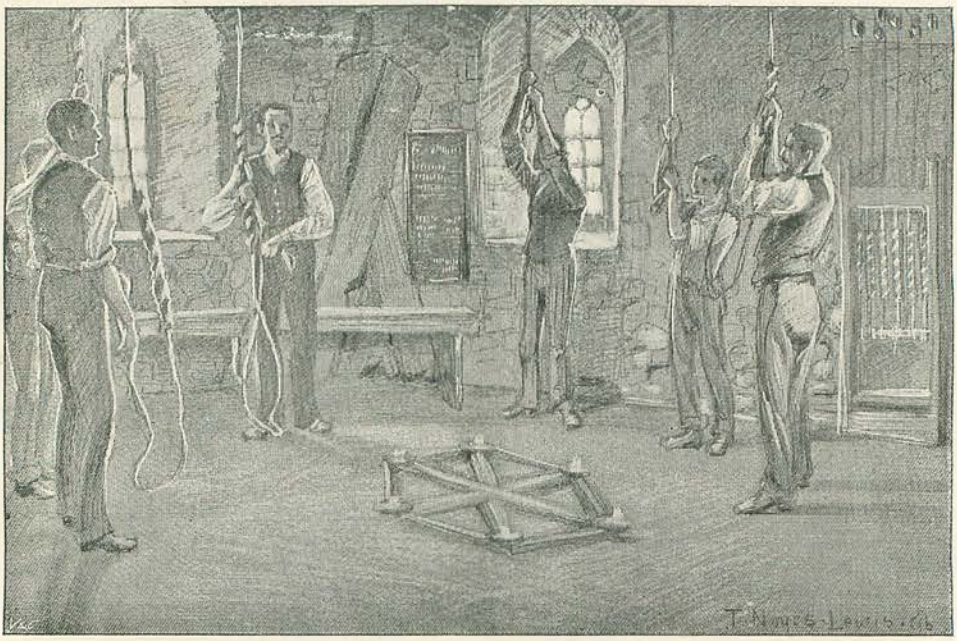
through the others, or of one other bell besides the treble, constitutes the distinction between the different systems. Thus we have the oldest system, "Grandsire," best adapted for an odd number of bells, in which the treble and one other bell pursue a straight path out and home again among the other bells; the "Plain Bob" system, in which the treble alone has a straight path; the "Court Bob" system is an offshoot from this, with more elaborate work for the other bells; Stedman's system, in which all the bells have a similar path; the "Treble Bob" system, so called because of the peculiar zigzag path pursued by the treble. To these has quite recently been added a fifth system, called "Alliance," in which the treble path is a combination of "Plain" and "Treble Bob" work. Under the head of each system there are several different methods of producing the changes, that is, several different ways of making the other bells work, some very simple, others very elaborate. These methods take their names mostly from localities where they were devised or first practised. All the systems and most of the methods are adaptable to any number of bells above four, the number being denoted by a distinctive *title* after the name of the method; thus, on the odd numbers, from three to eleven inclusive, the ringing is known, from the number of pairs of bells shifted at each change, as Singles, Doubles, Triples, Caters, and Cinques, respectively; and on even numbers, from four to twelve inclusive, as Minimus, Minor, Major, Royal, and Maximus, respectively. The full extent of the changes producible on each successive number of bells is computed by multiplying the last extent by the new number. Thus on two bells there are of course but two changes, 1, 2 and 2, 1. For three bells, multiply 2 by 3 = 6; for four bells, multiply 6 by 4 = 24, and so on. In this way we find that the extent on seven bells is 5040 changes, and this gives the measure for what ringers call a peal; nothing less than 5000 changes can constitute a peal, any less number being called a "touch."



CERTIFICATE OF THE SOCIETY OF ROYAL CUMBERLAND YOUTHS.

It would be impossible within the space at disposal here to initiate the general reader into all the mysteries of the art, all that can be done is to set down a few

elementary principles. The art consists of two branches, the one mechanical, the other intellectual, and there are few pursuits, if any, which give so free a scope for simultaneous mental and bodily exercise. The mechanical part lies in the management of the bell, and is of course the first thing to be learned. And although it is not every learner who becomes thoroughly skilled in even this initial stage, yet most beginners may hope, with a reasonable amount of practice under the supervision of an experienced ringer, to speedily acquire the mastery of a bell when not ringing with others. No one should essay to teach himself entirely, or some glimpses of the true art of ringing will begin to dawn upon the opening mind. In the case of the skilled ringer the management of the bell becomes by long practice an instinct, and gives him no trouble, unless a rickety frame and worn-out fittings above cause the bell to be uncertain and irregular in its action. With a bell that goes properly the ringer can concentrate all his attention on the motions of the other ropes, and the work of the method he has to follow, with a view to striking in his proper place with accurate evenness at each successive change; the great beauty of good ringing consisting in the rhythmical regularity of the striking.



RINGING A WEDDING PEAL AT MONKEN-HADLEY, MIDDLESEX.

he will get into difficulties and entanglements with the rope which will probably cause him to abandon the attempt abruptly. Let everyone therefore be content to be *taught* at first how to handle the rope properly—when to hold on and when to let go—that there may be no unnecessary collisions between the head of the operator and the ceiling of the ringing chamber. Further, while a tolerable amount of skill may soon be attained in ringing a bell by itself, it is another matter when it comes to ringing it evenly in company with four or five others. To do this well requires still further practice, in the course of which The rate of ringing in a peal of major, with bells of average weight, may be taken as twenty-six to twenty-seven changes per minute; and with eight bells to strike in each change, it will be seen that a small fraction of a second too soon or too late in the striking of any one bell becomes an appreciable portion of time, producing a broken effect in the ringing, which grates unpleasantly upon the ear. The mastery of the bell having been attained, the learner next turns his attention to the second stage of the art and learns the work of the method which he desires to ring. He studies on paper the path of a single bell

through a sufficient number of changes to give the entire work, and observes its relation to the path of the treble bell, which in most systems may be taken as a guide. He must learn this work by heart, and also the variations liable to be made in it from time to time by the calls given by the conductor of the ringing. And then he must practice, practice, practice, till he can guide his bell accurately among the others, according to the rule of the method. He begins with a simple method, and progresses gradually, as he finds opportunity, to more elaborate ones.

Now all this is not so easy as it seems. The bell may give no trouble, and the work of the method may be thoroughly known, but it is at first, and perhaps for some time, a puzzling matter to find one's way among the other bells. Whoever thinks it would be easy, let him try it, and tell us what he thinks about it after the experiment. It requires a combination of excellent qualities to make a ringer, and it is not the least of the recommendations of change-ringing that it tends to encourage the development of these qualities : quickness of eye and ear, collectedness, presence of mind, patience, perseverance, ability to meet repeated failures and disappointments without being disheartened or disgusted, good temper, and the acquired faculty known as "rope sight" ; all these are required in the practice of change-ringing, and the mixture is not found in every one.

True change-ringing must not be confounded with the wearisome repetition of one particular sequence and then of another, although this mode of ringing is much in vogue in certain localities under the name of change-ringing. In scientific ringing no repetition of any change is allowed, and the method, peal or touch which contains such repetition is said to be false. When the bells strike in their natural order, beginning with the smallest, the treble, and ending with the largest, the tenor, they are said to be ringing in rounds. When they are called into changes, each bell, as a rule, changes places with the one next to it, and from this point every swing of the bells produces a different change until the piece which is being rung is completed, when the bells fall into rounds again. Thus, to take the simplest way of producing the changes on six bells, from the sequence or row 123456, which is rounds, the first change is 214365. Now when a bell arrives at the first place in the sequence it is said to be leading, or at the lead, and strikes two blows in that position. Similarly, when a bell arrives in the last place, it is said to be behind, and strikes two blows there ; thus the second change will be 241635, and so on. It will be seen that the principle of the mutations is for the odd numbers to work, place by place, to the end of the row, and the even numbers, place by place, to the lead. If this is followed out the order in which the bells successively come to the lead will be 2, 4, 6, 5, 3, 1, and at the last blow of the treble lead all will fall into their proper positions as in rounds. But this would be only twelve changes. Therefore, to prevent rounds coming up so soon, a slight variation in the work must be made. This is effected by the evolution known as "dodging," which consists in an extra interchange of places between the bells of one or more pairs, while the bell next the treble strikes two blows in second's place instead of the bell behind striking two blows there. Thus the first change of the treble's lead being 132546, the last will be 135264, instead of 123456, which it would be if the ordinary work were followed. From this new sequence another set of twelve changes, called a lead, can be regularly produced as before ; the evolution being repeated at its close, a third set is introduced, and so on, the number of leads before the bells fall into rounds being one less than the number of bells engaged ; and the whole block of sixty changes thus produced constitutes a plain course. In this method the treble is not concerned in the evolutions, but pursues a straight path out and home again five times, the others being the working bells, and the path they each pursue, including the evolution of dodging and place-making, is the same for all, and constitutes the work of the method. But these sixty changes are only one-twelfth of the total number obtainable on six bells. Therefore to get the full extent other alterations must be made at intervals. These are called for by the conductor arbitrarily. When he makes a call the ringers alter the work of their bells accordingly. Generally the alteration is confined to three bells, which manœuvre so as to take each other's places in the order of coming down to lead, known as the "coursing order." The call which effects this is named a "bob," the origin of which elegant term is wrapped in obscurity. Sometimes only two bells take each other's places, when the call is made known as a single. By the alterations of coursing order caused by the proper

employment of these calls the full extent of 720 changes is produced without any repetition of any one change.

The arrangement of the calls to produce a peal on any higher number of bells of any length, or to possess certain musical qualities, is the province of the composer, whose work, and the knowledge necessary for it, is quite a distinct branch, constituting the science of campanology. Many of the best ringers know little or nothing of the principles of composition, and content themselves with performing the compositions sent to them by composers, or published in the ringing-books and periodicals. In the early days of the science there was keen competition among its professors to produce the best results and to solve the many difficult problems it presented. For years the production, by legitimate means, of the complete peal of Stedman Triples baffled the ingenuity and mocked the efforts of the most clever among the composers. Again and again the search was abandoned by successive workers, only to be taken up afresh by others, and pursued with dogged perseverance till the problem was solved. One J. Noonan, a composer in the early part of this century, used to declare that, in his search for the peal of Stedman Triples, he had used up as much paper as would cover the walls of St. Giles's Church! The history of these early efforts, and the tracking of the progressive steps by which the victory over this stubborn method was eventually obtained, is full of interest to the devotee, but would probably bore unutterably the general reader.