before proposing a remedy for them. We will take as an example a case with which we are all familiar: Tom, the clever boy, when at school shows a decided taste for drawing, and his sketches having been duly touched up or completely re-drawn by his master, are at vacation time brought home and exhibited by his fond parents to friends and relations with the same amount of pride as if they were rare impressions of Albert Dürer or The Carraccii. It is agreed by all that he is a very clever boy indeed, and has a decided taste for drawing. He goes on with his usual school course—plenty of classics and little or no science,—and accumulates more and more pencil sketches. At sixteen he completes his studies, and is, after some preliminary bargaining between his father and Mr. Blank, F.R.I., &c., as to the amount of fee and length of servitude, duly installed in the office of the aforesaid Mr. B., the eminent architect,—it being ten chances to one that up to that day Tom has not had the slightest notion of what an architect is, and is struck with astonishment at the large drawing-boards, squares, and other paraphernalia that meet his eyes. Mr. B. pats him on the head in a fatherly and affectionate manner, and says he is a very clever boy indeed; that his sketches are most beautiful, and evince a great deal of talent; that he will make him an architect in no time, together with other compliments highly flattering to our friend Tom's juvenile mind. He is ushered into the office, and finds he has for his companions two assistants and four or five pupils—the latter in various stages of being ground into architects in this first-class manufactory of the genuine article, where architects are turned out in the shortest time, and on the most moderate terms. Some are in a rough state, and others are almost quite polished and finished off—which means that they have spent nearly four years tracing plans for Mr. B., and occasionally varying that interesting occupation by holding the tape for one of the assistants when out measuring land or buildings. Tom has a board, squares, instruments, and paper placed before him, and is initiated by one of his companions in all the mysteries connected with compasses, Indian ink, rubber, drawing-pens, &c. After perhaps a month's preliminary training he gets his first tracing to make, and it is very probable that his attempt is a very poor one indeed; yet he improves after a time, and gets all that description of work; the other young gentlemen having his instruction in their hands, give him any job that may be distasteful to them, and set themselves out to teach him as little as possible outside the office work. So the four years pass over, Tom occasionally getting details to ink-in and drawings to clean up or copy, and varies the routine of office work by taking three, or perhaps four, months' shooting each year, with cricket matches and other amusements on an average of say twice a-week during the remaining eight months. The four years have expired, and he is handed over his indentures by Mr. B., who, if he has a large practice, may send him as clerk of works for a few months to some of his buildings, just to give him a start; or Tom, thinking his studies are over, if he has sufficient connexion or influence, takes an office, and comes forth into the world as a full-fledged architect.

Now, let us ask ourselves what has he acquired during his four years' servitude? It is probable that during the whole of that time he has not received one word of instruction from the man who has been paid to teach him his business, nor seen a specification, such documents being prepared by an assistant, or—a still worse practice—by a building surveyor outside the office altogether. He does not know how to make a perspective drawing, and it is likely cannot design the simplest thing without a wholesale raid on architectural works and the building journals; and it is almost certain that he has never seen an architect's certificate during the whole time; and as for construction, you might as well expect to find a knowledge of astronomy in a South Sea islander.

Although the inherent defects of the apprenticeship system are many and great, yet if our friend had been a studious boy, and paid attention to his studies, and taken some interest in learning his business, he would not be a by-word and a reproach to the profession, and a laughing-stock for builders and practical men, who cannot understand his plans, and fear to construct his roofs as shown on his drawings for a wholesome dread that they would certainly fit some of their workmen for a coroner's inquest. He would lose no opportunity of learning something, and would not copy a constructive drawing without asking himself the why and the wherefore of its different parts; he would learn Tredgold's and other works on carpentry, and carefully study Nicholson and our old friend Sir W. Chambers; he would get a specification occasionally, and copy it out, and in fact endeavour by all means in his power to obtain as much information as possible bearing on the profession which he has chosen. If he does this and fails, he will at least not have himself to blame for his non-success.

Let me impress on any of you who are pupils that now is the time to gain information, for any knowledge that will be acquired after you have commenced to practise will have been dearly bought, perhaps at the price of humiliation and disgrace, through some failure in your work that might have been avoided if during the golden hours of youth you had not wasted your time, and allowed the precious moments to pass by in idleness and indifference. It is not sufficient that you should pass through your four years' apprenticeship by just going through the routine of office work from 10 a.m. till 4 p.m. No time should be lost in idleness; you should bring home your master's books to read, and draw at home after hours. You should learn the principles of carpentry, and the uses of the different building materials, how to write a specification, to take out quantities, to measure up extras, check builders' accounts, and make valuations,—all which important matters are to be learned by keeping your eyes open, and observing the manner in which your master conducts his business, and by reading books bearing on those subjects. You should also learn to draw well and neatly both in pencil and ink, and, if you have the taste, in colours, and to make sketches from existing examples. You should learn projection, shadows, and, most of all, perspective; for none can be architects that have not an intimate knowledge of the principles and practice of perspective, or the appearance their designs will assume in execution.

THE BELLS AND CARILLON MACHINE, WORCESTER CATHEDRAL.

So much interest has been recently expressed concerning the bells and bell-chiming arrangements in Worcester Cathedral, that we are led to give a view and plan of the bells and bell-chamber, together with a view of the carillon machine recently completed there. The proposal to raise funds by subscription, to provide the cathedral with a clock and peal of bells, was originated by the Rev. Richard Cattley, minor canon of Worcester, and by his perseverance and devotedness to the object it has been successfully carried out. In his appeal Mr. Cattley said, "I have felt anxious for some time past that the noble tower of our cathedral, which rears itself with so much grandeur, not only over the city but also over the rich valley of the Severn that environs it, should, with the sanction of the Dean and Chapter, be furnished with a clock, in which all the resources of modern art (including, if practicable, daily telegraphic communication with Greenwich Observatory), together with the most finished workmanship, should be combined. And not only so; but, in order to complete a scheme worthy of Worcester, which from its rising importance now takes no mean place amongst the cities of England, I propose that we provide a peal of twelve bells, in the key of D flat, on the heavier of which the noted Westminster quarter-chimes would be sounded; and a bell of great power and magnitude, much after the model of the Leeds Town-hall bell, the note of which would be B flat, weighing nearly 5 tons, on which to strike the hours. The carrying out of this latter part of my plan is the hinge on which the whole practical utility of the scheme would turn, because by such a grand measure only would the time be distinctly indicated in every part; thus all other clocks could be regulated with perfect truthfulness; and I also make bold to say, without fear of contradiction, that the changes at the quarters, corresponding with the celebrated chimes to which I have just alluded, and answering to the deep-toned hour-bell, will present a combination which has not as yet been equalled, and will, moreover, only be surpassed when the unfortunate 'Big Ben' passes successfully through the founder's hands."

The sum named at first as the probable cost was about 4,000*l*. The greater part of the money was speedily raised, and the work was put in hand.

The casting of the bells was successfully completed by Messrs. John Taylor & Co., of Loughborough, and the tone is pronounced exceedingly fine.

The ringing peal consists of twelve, the weight of the tenor being 50 cwt.; note D flat. They are dedicated to the Twelve Apostles, and the name of the Apostolic Patron is cast in beautiful 15th-century letters on the waist of each bell. The Cambridge Quarter Clock Chimes necessitate an extra bell sounding D natural. This is dedicated to St. Paul.

The weight of each bell, with the title and note, is as follows:—

No.			cwt.	qrs.	lb.
1.	S. Matthias	A flat	6	3	19
2.	S. Judas Jacobi	G flat	7	0	22
3.	S. Simon Zelotes	F	7	2	10
4.	S. Jacobus Alphæi	E flat	8	3	0
5.	S. Matthæus	D flat	10	1	21
6.	S. Bartholomæus	C	11	0	24
7.	S. Thomas	B flat	12	0	0
8.	S. Philippus	A flat	15	2	11
9.	S. Andreas	G flat	21	2	11
10.	S. Joannes	F	26	1	8
11.	S. Jacobus	E flat	34	2	12
12.	S. Petrus	D flat	50	0	0
Extra Quarter Bell	S. Paulus	D	9	2	4
Total			221	3	12

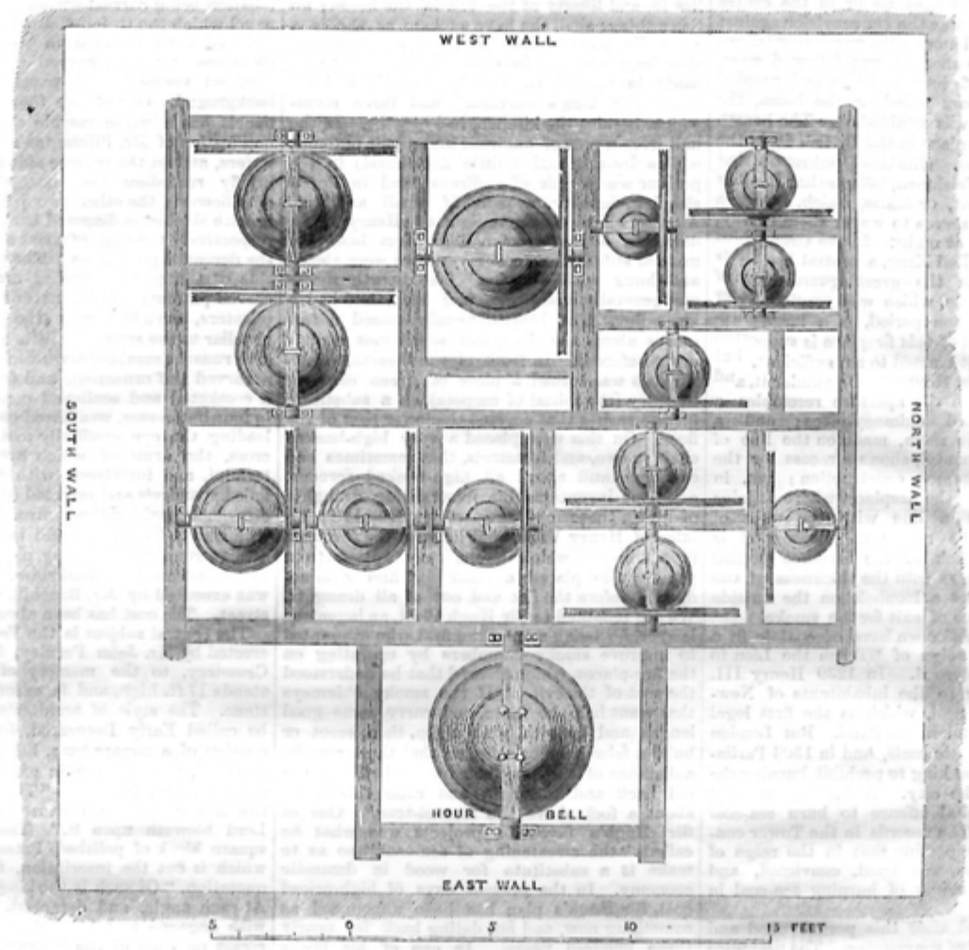
There is also the great bell, on which the hours will be sounded by a new and powerful clock, constructed by Messrs. Joyce, of Whitchurch, Salop (from the designs of Mr. E. B. Denison, Q.C.), weighing 4 tons, 10 cwt.; making a total weight of metal of 15 tons, 11 cwt., 3 qrs., 22 lb. This bell is a fine casting, and the note B flat is a remarkably true and full one. The ornamentation is of the same character as the peal bells. There are also four coats of arms on the waist—(1) England; (2) See of Worcester; (3) Dean and Chapter of Worcester; (4) City of Worcester. Round the crown is a text of Scripture, Eph. v. 14—"Surge qui dormis et exurge a mortuis, et illuminabit te Christus." (See Durandus de Campanis.) Also, on the lower part of the bell, in addition to the founder's name, is the following:—"*In usum Ecclesiæ Cathedralis Christi et beatæ Mariæ Virginis in Civitate et Comitatu Vigorniensi. Anno Domini MDCCCLXVIII.*"

The following is the estimated expenditure:—

Bells, oak frame, and all necessary fittings complete	£2,677
Clock, about	500
Timber trussing, floors, &c., about	1,200
Architect's commission, about	70
Gas-fittings	12
Chiming apparatus (Ellacombe's)	20
Wire for tower windows, about	35
Incidental expenses, including taking down old bells, printing, advertising, &c., about	200
	£4,714

The large bell was tolled for service for the first time by Mr. Denison and the Rev. H. T. Ellacombe, on Sunday, the 17th of January, 1869, in the company of Mr. Cattley and others.

A desire having been expressed for the restoration of the ancient musical chimes, which had fallen into decay many years ago, Messrs. Gillett & Bland, of Whitehorse-road, Croydon, who have brought the machinery for such chimes to great perfection, were called in, and have constructed a machine on a new and patented principle, a great improvement upon the original patent which was first applied to a set of Belgian bells in Boston Church. Since then the firm have effected many improvements, all of which have been introduced in the piece of mechanism under notice. It may be well to state that the chimes are the quarter-chimes of the clock. Mr. Ellacombe's chiming-hammers strike the bells inside with round hammers pulled by ropes, so that the success of the tunes or chimes depends entirely upon the skill of the performer; but the carillon machine is an automatic musician, the tunes being played entirely by machinery, and let off by the clock at the proper times. The carillon machine is constructed to play twenty-eight tunes on fifteen bells, but at present it will play seven tunes only on the ringing peal of twelve bells, occasionally introducing the great bell of 4½ tons, which has a grand effect. The tunes are original, composed for the purpose. This we are disposed to regard as a mistake.



Plan of the Bells and Bell Chamber, Worcester Cathedral.

Known tunes would have given more general satisfaction. When two extra bells are provided (which are essential in order to render the music of the Worcester carillons the finest in England), the other three barrels will be pricked with seven tunes on each. There are thirty-four keys to the machine, only twenty-four of which are now used. The machine is wound up every morning, and plays eight times in the course of twenty-four hours, a period of three hours elapsing between each performance. The same tune is repeated three times on each occasion, and it continues in action four minutes and a half. At the expiration of twenty-four hours the tune changes involuntarily, and in like manner the seven tunes of the barrel are consecutively played. Its connexion with the clock is by means of a lever, which, by a mechanical arrangement, is gently drawn when the time approaches, dislodging a pin, and thus setting the machine in motion. The motive power is obtained by weights, and the speed, as in clocks, is regulated by revolving vanes, capable of easy and instantaneous adjustment. The barrel, which is exactly on the same principle as that of a musical box, and is constructed to play seven tunes, is studded with brass pins, and in its revolution releases the detents and lets the hammer descend upon the bell; a cam-wheel of peculiar construction, continuously revolving, immediately draws the hammer back into a striking position, and forces the detents back into their proper place. When the bells are required for ringing, by a simple arrangement a bar is turned down on the keys, which prevents the machine being set in motion, so that the ringing may continue for any length of time without fear of interruption. The works of the machine are enclosed in a massive cast-iron frame, bolted together with iron nuts and bolts, and 7 ft. long, 4 ft. wide, and 4 ft. high, and weighing over 1½ ton. The motive power is given by weights, weighing 14 cwt., which are suspended by a steel line (280 ft. in length) from the iron barrel which drives the main wheel, and thus sets the whole machine in motion. The four musical barrels have seven tunes on each, and are 5 ft. long, 12 in. in diameter, and are made of mahogany, each being pricked with 1,100 brass pins, one-eighth of an inch square. There are twenty-six hammers for striking the bells, some of which weigh 2 cwt., 1¼ cwt., and 70 lb. each, altogether weighing 1,202 lb. The weight of the whole machine, including hammers, cranks, lines, &c., is nearly 4 tons of metal.

The great advantages claimed for the new system of carillon machinery are, that instead of the hammers being lifted up by the pins on the musical barrel (in the way common to all chiming machines on the old system), the two actions of lifting the hammers and letting them off to strike the bells are separated, so that the moment the hammers are released by the small pins on the musical barrel, they are again instantly raised into the striking position, their actions being perfectly simultaneous.

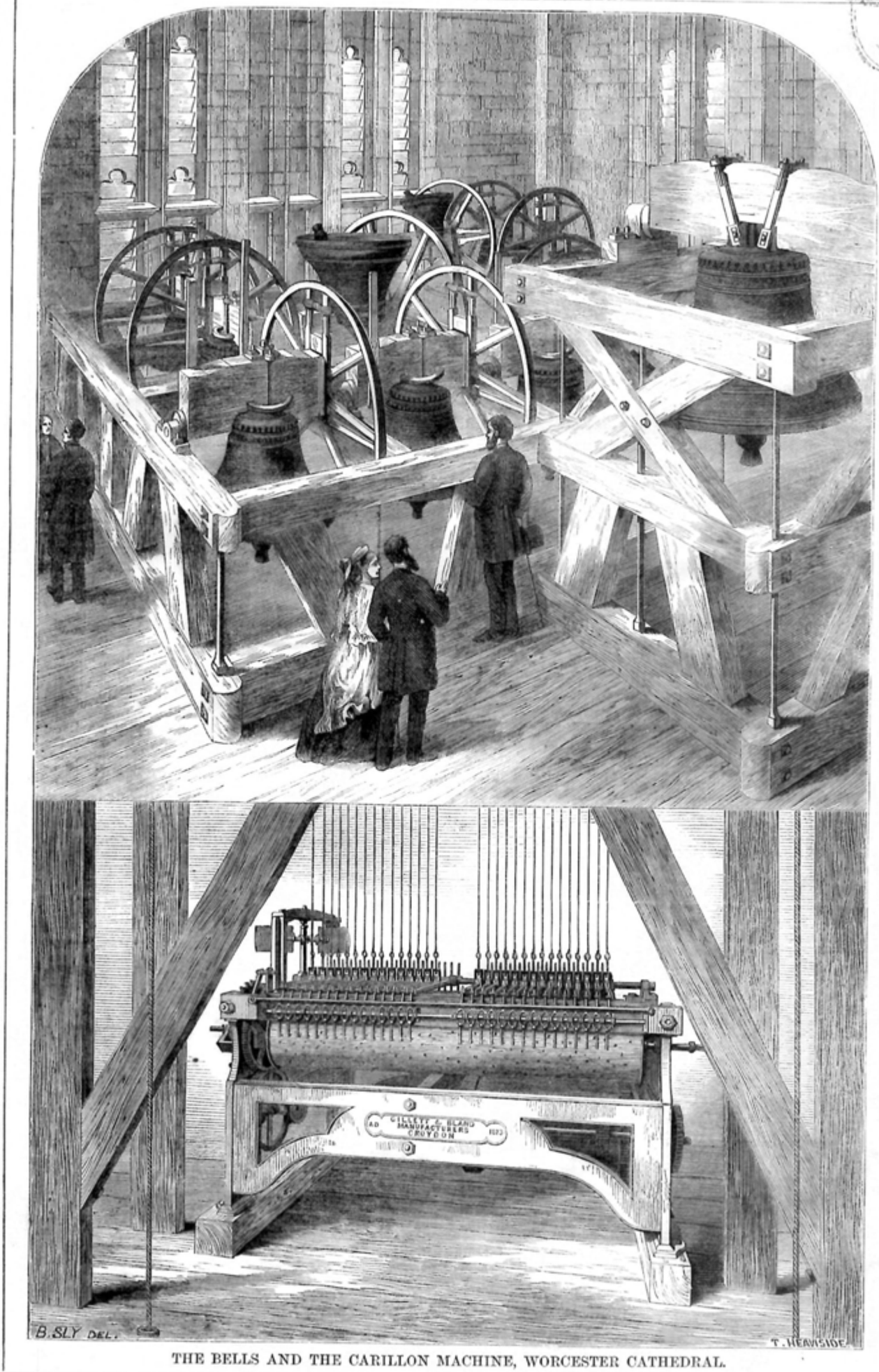
To show the facility with which the carillon machine acts upon the bells, it is stated that, notwithstanding the great weight of the hammers, an ivory key-board could be attached, the same as in a pianoforte, so that the tunes could be played upon the bells by the fingers as easily as playing a church organ, and any number of tunes could be played by having a series of musical barrels with seven tunes on each.

Disputes have arisen as to the authorship of certain improvements made in the carillon machine, and which may result in litigation We will not attempt to apportion the merit due to this or that person, but it seems clear to us, after some examination, that to Messrs. Gillett & Bland belongs the credit of having brought the machine to the condition in which we find it in Worcester Cathedral.

For the addition of the chimes to that cathedral the citizens of Worcester are indebted to the munificence of Mr. J. Wheeley Lea. The Rev. R. Cattley is to be heartily congratulated on the success which has attended his efforts to furnish the cathedral with a magnificent peal of bells, and to develop their excellence to the fullest possible extent.

FIRESIDE LORE.

THE paper on "Some of the Sanitary Aspects of House Construction," recently quoted in the *Builder*, furnishes a text for a gossip concerning fireside matters in the olden days. Going back to the grim gray dawn of history, we come to a time when fire was unknown. The oldest tradition relative to its discovery is that a Phœnician hunter observed a conflagration that had been excited in a forest by the attrition of some trees during a storm. To come down to later times: when Magellan visited the Marian Islands in 1521, the natives considered themselves to be the sole inhabitants of the world. They possessed none of what are termed the necessaries of life, and were in total ignorance of fire. Several of their huts being consumed during a thunderstorm, they considered the flame to be a kind of animal that attached itself to the wood and fed upon it. Martini, in his History of China, states that one of its earliest kings, following the inspiration of Heaven, first taught his countrymen the art of producing flame by rubbing pieces of wood together; then, says another Chinese historian, from being slaves of earth like the barbarians, the children of the Celestial Empire became the eyes of the world, for they alone could produce fire and convey it to places where it was wanted. But for this contrivance, a great portion of the globe must have remained a desert. Neither will our admiration of the discovery be diminished on finding that for many thousand years no improvement was made on the simple method by which the inventors first warmed themselves



THE BELLS AND THE CARILLON MACHINE, WORCESTER CATHEDRAL.