

forward to the freedom of that sunny day, mixed too with but few baser vanities or fears, for the local annual flower show is not a place for the display of costly elegance, and the prettiest girl is sure to be the plainest dressed. Who would not spare a few hours or a little trouble to brighten the scene where many an

innocent love may dare to strike its trembling root, or to lift the first bud of its perennial blossoming, which scorns time, and flings itself over graves to find a brighter sunshine and a richer soil beyond? Let not the gravest spurn our annual flower show.



THE PHONOGRAPH.

NOT seldom have the poets lightly scattered from their teeming fancy the ideas which later ages of science have slowly made good in fact. In Shelley's *Witch of Atlas* occur the following lines :—

“The deep recesses of her odorous dwelling
Were stored with magic treasures, sounds of air,
Which had the power all spirits of compelling,
Folded in cells of crystal silence there,
Such as we hear in youth, and think the feeling
Will never die—yet ere we are aware,
The feeling and the sound are fled and gone,
And the regret they leave remains alone.”

This beautiful poetic dream has within the last few months been rendered possible of material realisation by the invention of the Edison phonograph. The words of our lips, which formerly wasted themselves in air and were lost for ever, may now be treasured up and recalled for our pleasure, or rehearsed as a witness against us; and soul-compelling music may be caught in its flight and “folded in cells of crystal silence” for ages, then re-invoked to charm the ears of a generation yet unborn.

As the telephone enables us to propagate sound into space, so the phonograph admits of its being perpetuated into time. By the telephone, under favourable conditions, a person may converse with another over a distance of several hundred miles, as has been done recently in the pure atmosphere of Persia and Spain, without any stress of voice, and with the instantaneous velocity of electricity, rather than the

comparatively sluggish progress of sound in air. Similarly, by the phonograph, the words we utter now may be heard weeks, months, or even centuries hence, and in any part of the world to which the record may be sent meanwhile.

The telephone and phonograph are twin inventions—their names appeared almost simultaneously, one helping to suggest the other. Although differing essentially in their nature, it is a true instinct which classes them together, for they jointly confer on human speech its two most marvellous powers of extension. They are twin stars in the firmament of science, and one of the brightest constellations in the splendid galaxy of invention which has irradiated the nineteenth century. In CASSELL'S FAMILY MAGAZINE for February, we gave a full account of the articulating telephone, and all that was at that time foreshadowed of the phonograph. Since then the latter has been developing towards maturer powers, and making its *début* before the public in different countries. Wherever it has gone it has fully vindicated the startling reports which were circulated of its wonderful faculty, and has excited universal admiration. For the time at least, the phonograph, whose capacities are even more wonderful, has cast the telephone into the shade. Every highly novel invention passes through an early phase of cold incredulity, indifference, or repudiation, then is borne aloft on a burst of admiration and praise, which is succeeded by a period of calm criticism and practical tests. It is then relegated to its proper

place among the familiar contrivances of the past, and the only wonder is that it was not thought of before. So has it been with the telephone, and so will it be with the phonograph.

Mr. Thomas Alva Edison, the inventor of the phonograph, is a Canadian by birth, but now a naturalised citizen of the United States. He is the distinguished inventor of a number of highly ingenious and useful instruments, including the Edison telephone; the electric pen, for making fac-simile copies of drawings and documents with extraordinary rapidity; and, at least in part, of the only practicable quadruple system of telegraphy in use, whereby four messages, two from each end, can be sent over a single telegraph wire simultaneously. This system was recently introduced into our postal telegraphs, and is now constantly employed in conveying the heavy message traffic from London to Liverpool. He is chief constructor to the Great Western Union Telegraph Company in America, and resides at Menlo Park, New Jersey, near the manufactory of that Company.

One of the most remarkable features of the phonograph is its simplicity, and on seeing it and hearing it talk so perfectly, we are forced to smile at the involved and complex apparatus which have been invented from time to time by ingenious men, notably Faber, for the purpose of achieving the articulation of a few words. It is purely a mechanical contrivance, and no electricity is employed in operating it. It is well known that sound is due to mechanical oscillations or vibrations in air. A particular sound is a succession of condensations and rarefactions propagated through the air like a thrill. Each condensation and rarefaction constitutes a sound-wave. The *pitch* of the sound depends on the number of these waves which pass through the air in a second, the octave of a tone being produced by twice the number that is required to yield the tone itself. The peculiar quality or *timbre* of a sound, by which it is distinguished from another sound of equal pitch, and which enables us to recognise different voices and musical instruments, is the result of the particular *form* of the waves, that is to say, of the manner in which the condensation and rarefaction take place. The loudness of a sound is different from either of these properties, and depends solely on the force and intensity of the air vibration. If a membrane, capable of vibrating, be interposed in the path of a series of sound-waves, these waves beating upon the membrane will impart their oscillatory motion to it, and the middle of the membrane will swing to and fro in sympathy with the impulses of the air. Now if a rigid probe or stylus be fixed to the centre of the membrane, the motions of the latter may be impressed on some yielding substance, and thus the impalpable motions of the air may be recorded by tangible and permanent marks. These marks would be a graphical representation of the sounds passing in the air, but nothing more. In Barlow's logograph the stylus takes the form of a camel-hair pencil dipped in colour, and it delineates the vibrations of the air by an undulatory line drawn

on a moving strip of paper. To make the record reproduce the same sounds which gave rise to it, the impression must be such as to set a free membrane vibrating in a precisely similar manner to that which vibrated under the sounds recorded. It is this problem which the phonograph solves.

As shown in the figure, the phonograph consists of a metal cylinder, about six inches long and three inches in diameter, fixed on an axle which is rotated by the handle, and in this way caused to travel both ways through a length equal to that of the cylinder itself. Round the surface of this cylinder is cut a fine spiral groove of a V-shaped section, each turn of the groove being about one-tenth of an inch from the next. To control and adjust the motion of the cylinder, there is a screw-thread on the axle, of a pitch so proportioned that one turn of the axle advances the cylinder by one turn of the groove—that is to say, by one-tenth of an inch. A vibrating diaphragm or membrane in a ring-frame is supported over the cylinder by a support, which can be shifted along the barrel of the cylinder and clamped at any point. On the under side of the membrane is a fine steel probe, or stylus, with a chisel-shaped point. This is the marker for impressing the sound to be registered; but instead of fixing it direct to the centre of the membrane, a better effect is got by supporting it on the end of a delicate spring, and interposing between the centre of the membrane and the head of the stylus a small piece of india-rubber which bears like a cushion on the latter. It is clear that when one speaks into the membrane the vibrations set up in it, corresponding to the sounds received, will be communicated to the stylus, which will rapidly dart up and down. To receive the impressions of this motion, a sheet of ordinary tinfoil is lapped smoothly round the barrel of the cylinder; the diaphragm is clamped in such a position that the point of the stylus is brought fairly over the tinfoil at a point where it covers the V-shaped groove. On turning the barrel by rotating the handle, and speaking against the membrane, the stylus, keeping faithfully *en rapport* with the vibrations of the latter, probes up and down into the tinfoil, which is soft and yielding over the cavity of the groove underneath, and marks its passage by a series of indentations along the line of the groove. This line of indentations, which to the eye looks like a score idly drawn on the foil by the point of a nail, is in reality a visible speech like the graphic delineation of Barlow's logograph. All the properties of the sound which caused it have chiselled their impress upon it—the pitch of the sound by the number of waves or indentations in a given length, the timbre by the form of the indentations, and the intensity by their depth, as may be seen by examining it with a magnifying glass. Noise, music, and speech, all conceivable sounds, may be sculptured upon it. To reproduce what has been spoken, it is only necessary to remove the diaphragm and turn the barrel back again to its first position, then reset the diaphragm. On rotating the barrel as before, the style, this time passive, is set in motion by the indented score of the foil, and rising and sinking over its corrugations, throws the

diaphragm into vibration, and causes it to give out to the air the same sounds which before had been received from it. A funnel or horn, placed in the position shown by dotted lines, is employed to reinforce and project the sounds given out. To secure a uniformity in the rotation of the crank, a heavy fly-wheel is affixed to the axle.

The form of phonograph above described, although quite well adapted for the laboratory, is in some respects unsuitable for practical and public use; and Mr. Edison is now engaged in devising a finished instrument capable of storing up speeches and music of all kinds, and of allowing the records to be sent by post, and the sounds perfectly reproduced at another place some time after. In this instrument, we are told, a circular plate will take the place of the cylinder. The groove will be cut on this plate in the form of a volute spiral, and a similar spiral cut on the under side of the plate will guide the arm carrying the diaphragm, so that the stylus will always travel along the groove. A sheet of tinfoil kept outspread by a paper frame will be laid over this plate, and so fixed that it can be lifted off again, sent by post, and fixed on a similar instrument without crushing the score. The record will be taken by setting the stylus over the centre of the spiral, and rotating the plate so as to cause the stylus to follow the spiral outwards. To secure a uniform motion to the plate, a train of wheelwork will be employed instead of turning by hand, and it will be possible to start and stop the plate at any point.

Since it was first invented, the articulation of the phonograph has been much improved, and the first feeble lisplings of its infancy have given place to a full and strong utterance, which, although not quite perfect yet, is in the latest forms said to imitate any familiar voice to the point of recognition. At the Society of Telegraph Engineers in London, the phonograph recently gave a performance that created much mirth and astonishment. The instrument exhibited was the second ever made, and of the type shown in our figure. There was absolute silence in the hall, followed by a burst of surprised and delighted applause, when the little piece of mechanism on the table plainly uttered, with a comical assurance all its own, "The phonograph presents his compliments to the audience." It then recited poetry, sang songs, coughed and crowed, laughed heartily, and gave vent to a succession of jubilant hurrahs. One after another, in an amusing parody of human speech, it truthfully expressed a variety of emotions—enthusiasm, merriment, patriotism, and even pathos—and proved itself capable of reproducing, at least to a certain extent, the individual tone and manner of the speaker that it mimicked. Finally the phonograph sang the National Anthem with quite a stirring effect; and it was as much a compliment to Mr. Edison, and a tribute to the powers of his instrument, as a mark of loyalty to the Queen, that the audience the while remained standing.

The powers of the phonograph are so unexpected and wonderful, that we have not yet fully awakened to all the manifold purposes to which it may be applied;

but it is not difficult by a little reflection to foresee a number of these. In the science of sound it will open up a new field of research; and even already some curious results have been obtained from it. For instance, it has been found that the vowel and consonant sounds are given out just the same whether the machine is worked backwards or forwards, so that letters or elements of speech are reversible sounds. The well-known fact that the pitch of a note depends on the rate of vibration of the air producing it is strikingly illustrated by causing a person with a bass voice to speak into the phonograph, and then rotating the cylinder more rapidly in reproducing it than in registering it. In this way the deep bass tones may be made in turn to pass through baritone and tenor up to a piping treble. Similarly the shrill notes of a soprano can be suddenly changed into a low bass, in a manner worthy of the most gifted negro minstrel. As an audible alarm the phonograph is certain to take the place of many existing bell and gong signals, and notices or semaphores. It will appeal to the ear rather than to the eye, and thus both senses will in future act as means of advertisement. Mr. Edison expects that within a year the phonograph will be at work on the stores of New York and the shops of London, calling out to passers-by the price and qualities of the wares within—"Two cents for a shave," and so forth. We can only hope that his prophecy will be falsified by a benevolent Board of Works as far as London is concerned, for the babel is loud enough there as it is. For purposes of this kind the flimsy and perishable record of tinfoil will have to be superseded by a rigid metallic matrix copied from the foil by a stereotyping or electrotyping process. Durable matrices of this kind can be readily inserted into dolls and other toys, so as to enable them to talk. Already we hear that Mr. Barnum intends constructing a new effigy of the late Edwin Forrest, the American actor, which shall deliver the soliloquy from *Hamlet*, "To be or not to be," with all the impressive solemnity characteristic of the great tragedian. There is little doubt but that Madame Tussaud's wax figures of celebrated personages yet to arise will not only copy their appearance and dresses, but also their voices, with startling fidelity. The coming man will awake in the morning by a clock which announces the hour, and adds a wholesome hint on the merits of early rising. He will hear his letters talked to him by his phonograph, and answer them by dictating to it and despatching the records by post. If he has a complaint to make against an importunate cabman, he will make it to the tell-tale phonograph set up inside the cab, stating his name and address. The surliness of railway officials will no more ruffle his serenity, for the starting of his train will be proclaimed to him by phonograph in a loud voice, and with all the unctuous urbanity that could be desired. If during the course of the day he should transact important business in the City before referees, a reporting phonograph will be there to take down every word that has been uttered; for shorthand writers will have found their occupation gone. In the evening he can amuse himself by listen-

ing to his phonograph rehearsing the beautiful strains of some *prima donna* who has herself ceased to exist, but has left her song behind her like an echo to keep her memory sweet; or he can hear the phonograph recite to him, with all the arts of elocution, some masterpieces of poetry and the drama. If he goes to a public lecture on some illustrious person of the past—some great statesman or orator of our own time, perhaps—he will be presented with a likeness of him which may be literally a speaking one, for the phonograph will at the same time deliver accurate imitations of his eloquence. How interesting would it be, for instance, to have a museum wherein were treasured up some of the memorable sayings of our national history—the last speech of the Great Commoner, or the famous command of Wellington to the Guards at Waterloo! It has long been a regret of the artist that he cannot paint sound, but in the theatre of the future the scenery will be enlivened by the fitting sounds of nature or art, and the realistic illusion rendered all the more complete. The night-

ingale will warble his liquid notes in the village lane, and the brook will murmur musically as it sparkles over its bed. The whistling of the wind through the tempest-tost wood, the furious rattle of the rain on the wet leaves, will all be imitated from nature by the phonograph; and the rumbling of barrel-thunder will be heard no more. The familiar noises of streets, the puffing of a railway train, and even the multitudinous din and tumult of a battle, may be imported into certain scenes to endow the effect with all the vivid power of reality. Even the orchestra may take the form of a phonographic organ revolved by mechanism. We have photographic albums now; there will be phonographic ones in the future. "It will be possible a generation hence," says Mr. Prescott, a distinguished American electrician, "to take a file of phonograph letters spoken at different ages by the same person, and hear the early prattle, the changing voice, the manly tones, and also the varying manner and moods of the speaker, so expressive of character, from childhood up."

J. MUNRO, C.E.

THE GATHERER.

The Block in the City Streets.

Some important observations on the causes of the frequent stoppage of the street traffic in the City of London—more especially in the immediate neighbourhood of London Bridge—have been made by the Commissioner of City Police, which seem to deserve attention. In a report to the Police Committee, Colonel Fraser—who speaks with authority on the subject—states that in his opinion the obstruction and delay which so often arise, more particularly with heavy vehicles proceeding towards the East End, are not, as many suppose, attributable to the narrowness of London Bridge, but rather to the insufficient width of some of the streets at the northern end of the bridge, into which the main portion of the traffic is compelled to pass. The three streets to which he alludes are Great Tower Street, from Little Tower Street to Mark Lane; Lower Thames Street, from Fish Street Hill to St. Mary-at-Hill; and especially the western end of Fenchurch Street as far as Lime Street; and the inconvenience which is liable to be occasioned in these thoroughfares, and the necessity for increasing their width, which Colonel Fraser urges upon the Committee, are apparent when we learn that in neither of them does the breadth between the footways exceed fifteen feet. This space is large enough only to permit the passage of two lines of traffic, the consequence being that the temporary stoppage of a single vehicle for any purpose brings the whole stream of one line to a standstill, while in the case of Fenchurch Street—which is more important than either of the others—there is not only this disadvantage to contend with, but there are also further difficulties, caused first by the additional traffic received from Lombard Street, and next by the numerous accidents to horses occasioned by the asphalt roadway. London Bridge, on

the other hand, is, says Colonel Fraser, the only important thoroughfare in which serious stoppages of the traffic seldom occur, and he gives as reasons for this that the bridge is of uniform breadth throughout, that it provides ample room for two lines of vehicles in each direction, and that, it being devoid of buildings of any kind, drivers of carriages and vans have no necessity or inducement to linger on the way.

A Sailing Car.

Nearly 250 years ago great astonishment was excited by the performances of some Dutch sailing carriages which actually travelled a distance of forty-two miles in two hours—an unheard-of speed in those times. Of course the mode of locomotion entirely depended upon the state of the wind, and it could therefore only be made available under certain favouring circumstances. With the invention of railways, the wind carriage fell into disuse for many years—though, indeed, there is no reason to believe that it was ever anywhere very common—but it now appears not unlikely that it may be revived in some districts, because of these very railways which had temporarily put a stop to it. At all events, for a considerable time past a sailing car has been advantageously employed on the Kansas Pacific Railroad for the purpose of conveying repairing parties to pumps, telegraph-wires, &c., along the route. The vehicle has an average speed of thirty miles an hour, but with a strong breeze right abeam it is capable of traversing forty miles in the same period. The car has four wheels, each thirty inches in diameter, is six feet long, and weighs 600 lbs. The sail has two booms, respectively fourteen and fifteen feet in length, with an area of about eighty-one square feet. The mast is eleven feet high. When it is necessary to bring the car to a standstill, all that