

## EDISON'S INVENTION OF THE KINETO-PHONOGRAPH.

In the year 1887, the idea occurred to me that it was possible to devise an instrument which should do for the eye what the phonograph does for the ear, and that by a combination of the two, all motion and sound could be recorded and reproduced simultaneously. This idea, the germ of which came from the little toy called the Zoetrope, and the work of Muybridge, Maris, and others has now been accomplished, so that every change of facial expression can be recorded and reproduced life size. The Kinetoscope is only a small model illustrating the present stage of progress but with each succeeding month new possibilities are brought into view. I believe that in coming years by my own work and that of Dickson, Muybridge Maris and others who will doubtless enter the field, that grand opera can be given at the Metropolitan Opera House at New York without any material change from the original, and with artists and musicians long since dead.

The following article which gives an able and reliable account of the invention has my entire endorsement. The authors are peculiarly well qualified for their task from a literary standpoint and the exceptional opportunities which Mr Dickson has had in the fruition of the work.

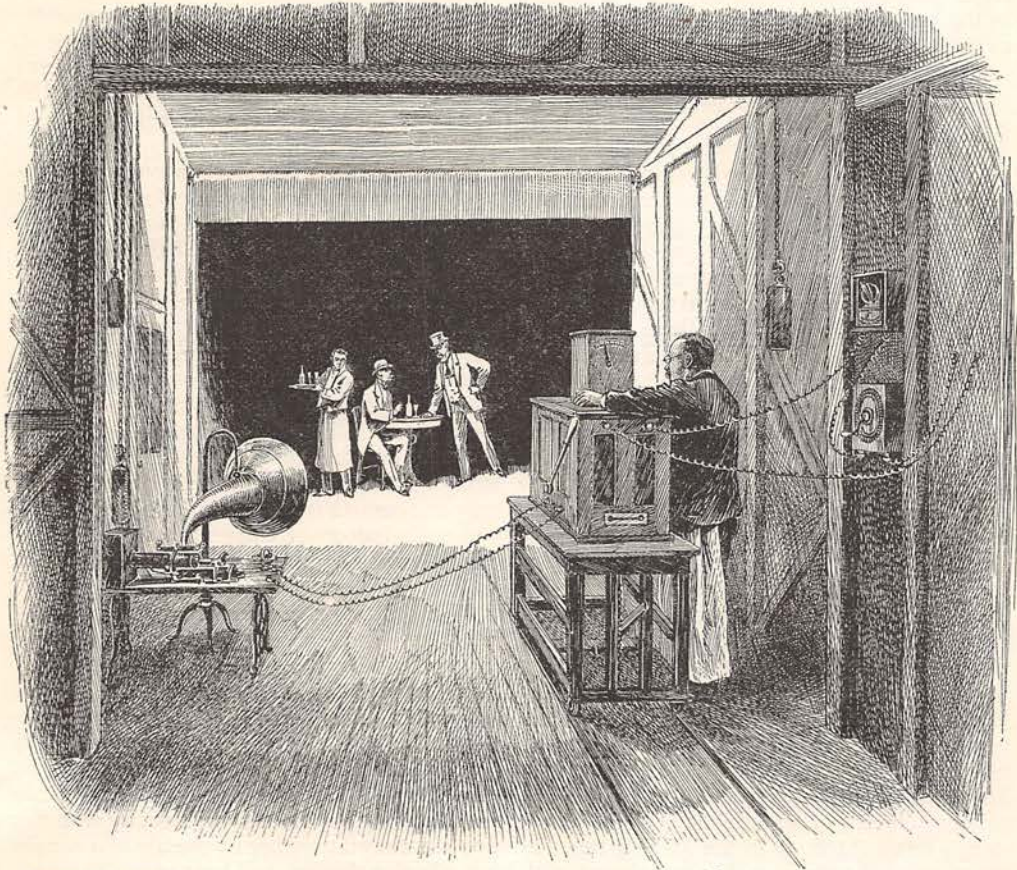
Thomas A Edison

## ACCOUNT OF THE INVENTION.<sup>1</sup>

THE synchronous attachment of photography with the phonograph was early contemplated by Mr. Edison, in order to record and give back the impressions to the eye as well as to the ear.

The comprehensive term for this invention is the kineto-phonograph. The dual "taking-

age impressed on the sensitive surface of the shell. The photographic portion of the undertaking was seriously hampered by the defects of the materials at hand, which, however excellent in themselves, offered no substance sufficiently sensitive. How to secure clear-cut outlines, or indeed any outlines at all, to-



DRAWN BY E. J. MEEKER.

INTERIOR OF THE KINETOGRAPHIC THEATER, EDISON'S LABORATORY, ORANGE, N. J., SHOWING PHONOGRAPH AND KINETOGRAPH.

machine" is the phono-kinetograph, and the reproducing-machine the phono-kinetoscope, in contradistinction to the kinetograph and the kinetoscope, which relate respectively to the taking and reproduction of movable but *soundless* objects.

The initial experiments took the form of microscopic pin-point photographs, placed on a cylindrical shell, corresponding in size to the ordinary phonograph cylinder. These two cylinders were then placed side by side on a shaft, and the sound record was taken as near as possible synchronously with the photographic im-

gether with phenomenal speed, was the problem which puzzled the experimenters. The Daguerre, albumen, and kindred processes met the first requirements, but failed when subjected to the test of speed. These methods were therefore regretfully abandoned, a certain precipitate of knowledge being retained, and a bold leap was made to the Maddox gelatine bromide of silver emulsion, with which the cylinders were coated. This process gave rise to a new and serious difficulty. The bromide of silver haloids, held in suspension with the emulsion, showed themselves in an exaggerated coarse-

<sup>1</sup> The text and pictures of this article copyright, 1894, by ANTONIA & W. K. L. DICKSON.

The photographs are by Mr. Dickson.

ness when it became a question of enlarging the pin-point photographs to the dignity of one eighth of an inch, projecting them upon a screen, or viewing them through a binocular microscope. Each accession of size augmented the difficulty, and it was resolved to abandon that line of experiment, and to revolutionize the whole nature of the proceedings by discarding these small photographs, and substituting a series of very much larger impressions affixed to the outer edge of a swiftly-rotating wheel, or disk, and supplied with a number of pins, so arranged as to project under the center of each picture. On the rear of the disk, upon a stand, was placed a Geissler tube, connected with an induction coil, the primary wire of which, operated by the pins, produced a rupture of the primary current, which, in its turn, through the medium of the secondary current, lighted up the Geissler tube at the precise moment when a picture crossed its range of view. This electrical discharge was performed in such an inappreciable fraction of time, the succession of pictures was so rapid, and the whole mechanism so nearly perfect, that the goal of the inventor seemed almost reached.

Then followed some experiments with drums, over which sheets of sensitized celluloid film were drawn, the edges being pressed into a narrow slot in the surface, similar in construction to the old tin-foil phonograph. A starting- and stopping-device very similar to the one now in use was also applied. The pictures were then taken spirally to the number of two hundred or so, but were limited in size, owing to the roundness of surface, which brought only the center of the picture into focus. The sheet of celluloid was then developed, fixed, etc., and placed upon a transparent drum, bristling at its outer edge with brass pins. When the drum was rapidly turned, these came in contact with the primary current of an induction coil, and each image was lighted up in the same manner as described in the previous disk experiment, with this difference only, that the inside of the drum was illuminated.

The next step was the adoption of a highly sensitized strip of celluloid half an inch wide; but this proving unsatisfactory, owing to inadequate size, one-inch pictures were substituted on a band one and a half inches wide, the additional width being required for the perforations on the outer edge. These perforations occur at close and regular intervals, in order to enable the teeth of a locking-device to hold the film steady for nine tenths of the one forty-sixth part of a second, when a shutter opens rapidly and admits a beam of light, causing an image or phase in the movement of the subject. The film is then jerked forward in the remaining one tenth of the one forty-sixth part of a

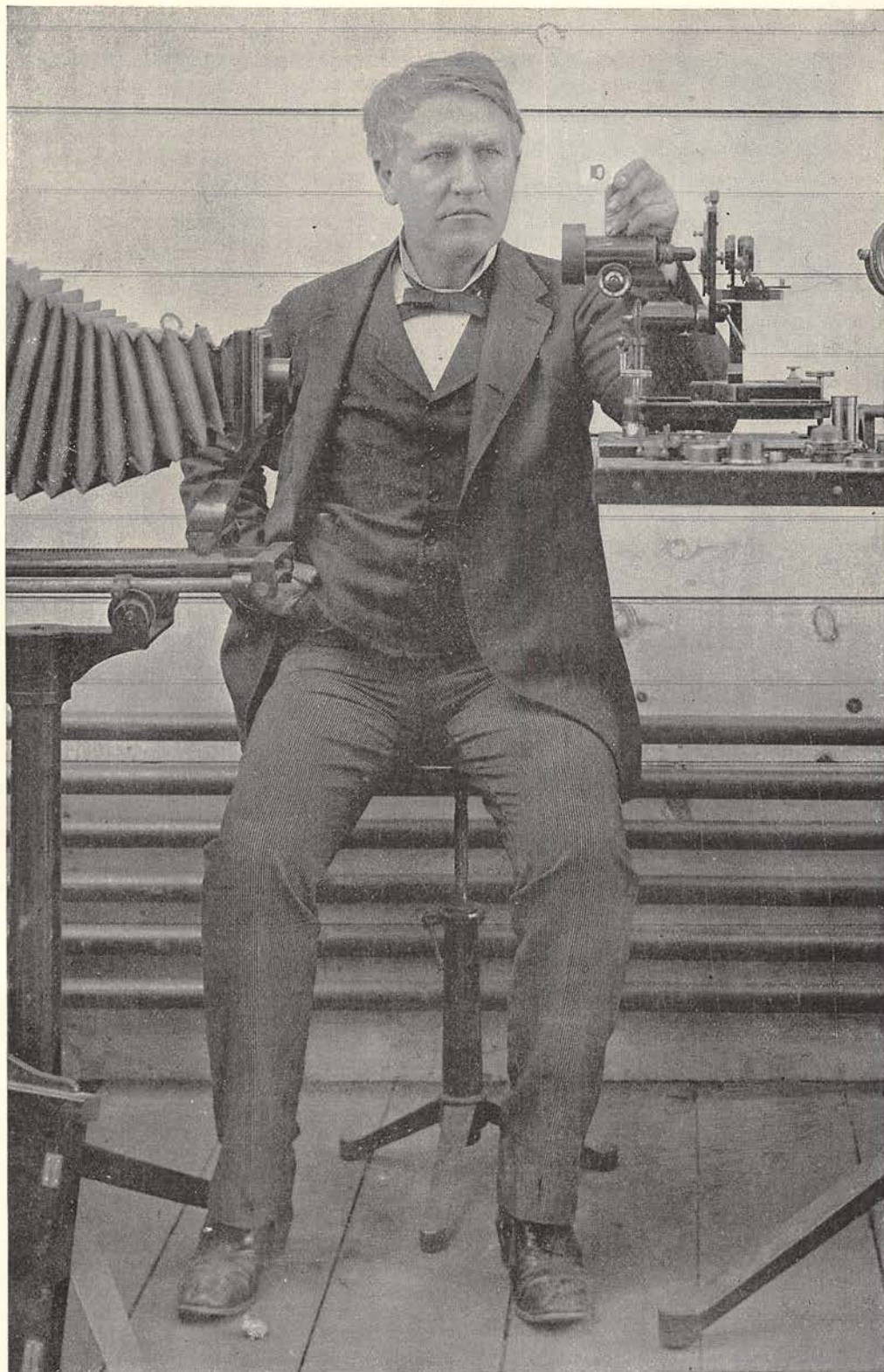
second, and held at rest while the shutter was again made its round, admitting another circle of light, and so on until forty-six impressions are taken a second, or 2760 a minute. This speed yields 165,600 pictures in an hour, an amount amply sufficient for an evening's entertainment, when unreel'd before the eye. By connecting the two ends of the strip, and thus forming a continuous band, the pictures can be indefinitely multiplied. In this connection it is interesting to note that were the spasmodic motions added up by themselves, exclusive of arrests, on the same principle that a train record is computed independent of stoppages, the incredible speed of twenty-six miles an hour would be shown.

The advantage of this system over a continuous band, and of a slotted shutter forging widely ahead of the film, would be this, that in that case only the fractional degree of light comprised in the  $\frac{1}{2760}$  part of a second is allowed to penetrate to the film at a complete sacrifice of all detail, whereas, in the present system of stopping and starting, each picture gets one hundredth part of a second's exposure, with a lens but slightly stopped down—time amply sufficient, as any photographer knows, for the attainment of excellent detail even in an ordinarily good light. It must be understood that only one camera is used for taking these strips, and not a battery of cameras, as in Mr. Muybridge's photographs of "The Horse in Motion."<sup>1</sup>

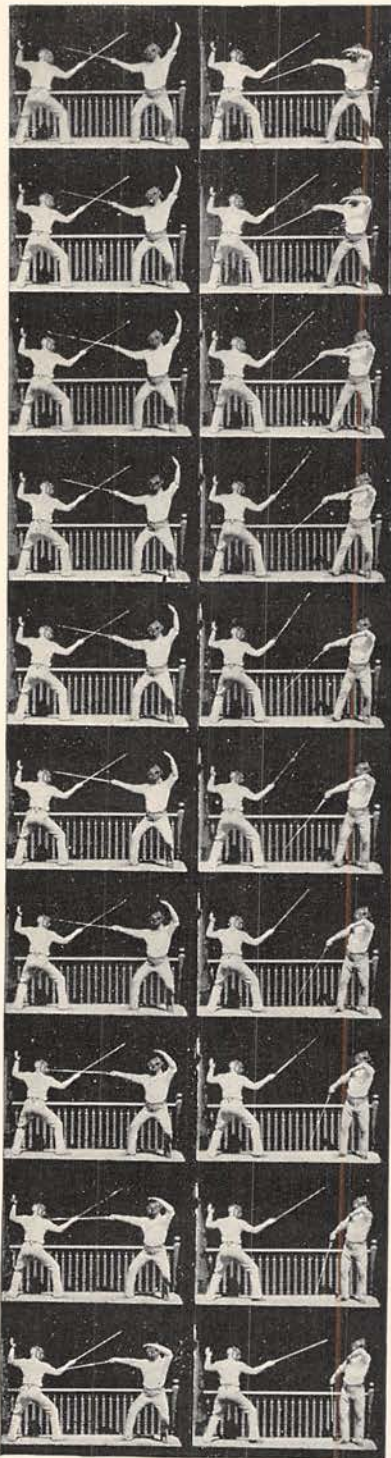
The next step, after making the negative band, is to form a positive or finished series of reproductions from the negative, which is passed through a machine for the purpose, in conjunction with a blank strip of film, which, after development and general treatment, is replaced in the kinetoscope or phono-kinetoscope, as the case may be. When a phonograph record has been taken simultaneously with such a strip, the two are started together by the use of a simple but effective device, and kept so all through, the phonographic record being in perfect accord with the strip. In this conjunction, the tiny holes with which the edge of the celluloid film is perforated, correspond exactly with the phonographic records, and the several devices of the camera, such as the shifting of the film and the operations of the shutter, are so regulated as to keep pace with the indentation made by the stylus upon the phonographic wax cylinder, one motor serving as a source of common energy to camera and phonograph, when they are electrically and mechanically linked together.

The establishment of harmonious relations between kinetoscope and phonograph was a harrowing task, and would have broken the spirit of inventors less inured to hardship and discour-

<sup>1</sup> See THE CENTURY for July, 1882.



THOMAS A. EDISON, 1893.



THE FENCERS. TWO SECTIONS OF THE KINETOSCOPIC BAND, SHOWING MINUTE GRADATIONS IN POSE.

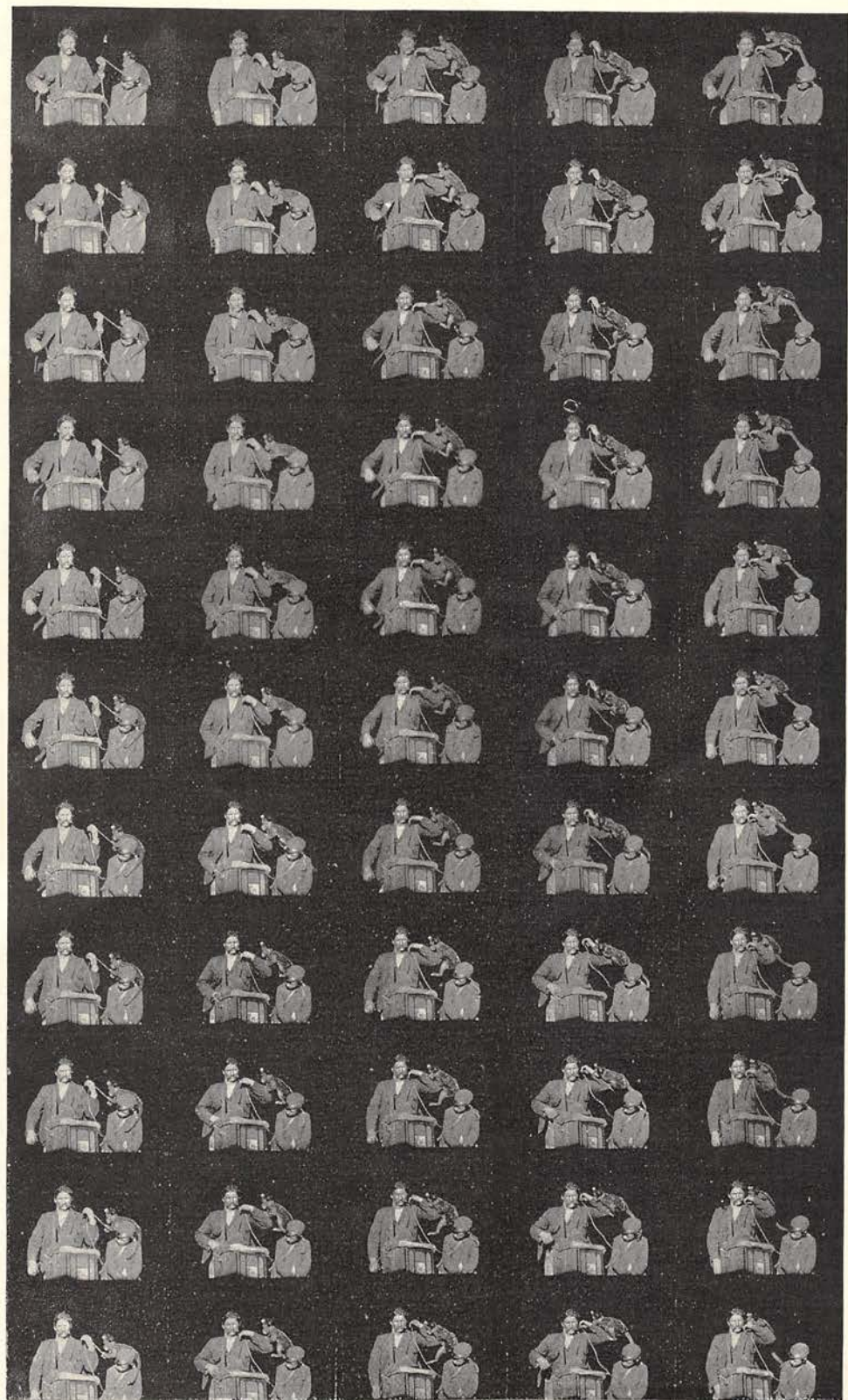
agement than Edison's veterans. The experiments have borne their legitimate fruit, and the

most scrupulous nicety of adjustment has been achieved, with the resultant effects of realistic life, audibly and visually expressed.

The process of "taking" is variously performed: by artificial light in the photographic department, or by daylight under the improved conditions of the new theater, of which we shall speak. The actors, when more than one in number, are kept as close together as possible, and exposed either to the glare of the sun, to the blinding light of four parabolic magnesium lamps, or to the light of twenty arc-lamps, provided with highly actinic carbons, supplied with powerful reflectors equal to about 50,000 candle-power. This radiance is concentrated upon the performers while the kinetograph and phonograph are hard at work storing up records and impressions for future reproduction.

A popular and inexpensive adaptation of kinetoscopic methods is in the form of the well-known nickel-in-the-slot, a machine consisting of a cabinet containing an electrical motor and batteries for operating the mechanism which acts as the impelling power to the film. The film is in the shape of an endless band fifty feet in length, which is passed through the field of a magnifying-glass perpendicularly placed. The photographic impressions pass before the eye at the rate of forty-six per second, through the medium of a rotating, slotted disk, the slot exposing a picture at each revolution, and separating the fractional gradations of pose. Projected against a screen, or viewed through a magnifying-glass, the pictures are eminently lifelike, for the reason that the enlargement need not be more than ten times the original size. On exhibition evenings the projecting-room, which is situated in the upper story of the photographic department, is hung with black, in order to prevent any reflection from the circle of light emanating from the screen at the other end, the projector being placed behind a curtain, also of black, and provided with a single peep-hole for the accommodation of the lens. The effect of these somber draperies, and the weird accompanying monotone of the electric motor attached to the projector, are horribly impressive, and one's sense of the supernatural is heightened when a figure suddenly springs into his path, acting and talking with a vigor which leaves him totally unprepared for its mysterious vanishing. Projected stereoscopically, the results are even more realistic, as those acquainted with that class of phenomena may imagine, and a pleasing rotundity is apparent, which, in ordinary photographic displays, is conspicuous by its absence.

Nothing more vivid or more natural could be imagined than these breathing, audible forms, with their tricks of familiar gesture and speech. The inconceivable swiftness of the photographic



"HEAR ME, NORMA." KINETOSCOPIC VIEWS, SHOWING FIVE SECTIONS OF THE STRIP.

successions, and the exquisite synchronism of the phonographic attachment, have removed the last trace of automatic action, and the illusion is complete. The organ-grinder's monkey jumps upon his shoulder to the accompaniment of a strain from "Norma." The rich strains of a tenor or soprano are heard, set in their appropriate dramatic action; the blacksmith is seen swinging his ponderous hammer, exactly as in life, and the clang of the anvil keeps pace with his symmetrical movements; along with the rhythmical measures of the dancer go her soft-sounding footfalls; the wrestlers and fencers ply their intricate game, guarding, parrying, attacking, thrusting, and throwing, while the quick flash of the eye, the tension of the mouth, the dilated nostrils, and the strong, deep breathing give evidence of the potentialities within.

The photographic rooms, with their singular completeness of appointment, have been the birthplace and nursery of this invention; and the more important processes connected with the preparation and development of the film, together with other mechanical and scientific devices, are still carried on in this department. The exigencies of natural lighting incident to the better "taking" of the subjects, and the lack of a suitable theatrical stage, however, necessitated the construction of a special building, which stands in the center of that cluster of auxiliary houses which forms the suburbs of the laboratory, and which is of so peculiar an appearance as to challenge the attention of the most superficial observer. It obeys no architectural rules, embraces no conventional materials, and follows no accepted scheme of color. Its shape is an irregular oblong, rising abruptly in the center, at which point a movable roof is attached, which is easily raised or lowered at the will of a single manipulator. Its color is a grim and forbidding black, enlivened by the dull luster of many hundred metallic points; its material is paper, covered with pitch and profusely studded with tin nails. With its flapping sail-like roof and ebon hue, it has a weird and semi-nautical appearance, and the uncanny effect is not lessened when, at an imperceptible signal, the great building swings slowly around upon a graphited center, presenting any given angle to the rays of the sun, and rendering the operators independent of diurnal variations. The movable principle of this building is identical with that of our river swinging-bridges, the ends being suspended by iron rods from raised center-posts. This building is known as the Kinetographic Theater, otherwise the "Black Maria." Entering, we are confronted by a system of lights and shades so sharply differentiated as to pain the eye, accustomed to the uniform radiance of the outer air. Later we find that the contrasts are effected by the total

exclusion of light from the lower end of the hall, heightened by draperies of impenetrable black, against which stands out in sharp relief the central stage, on which are placed the kinetographic subjects, bathed in the full power of the solar rays pouring down from the movable roof. This distribution of light and shade is productive of the happiest effects in the films, as the different figures are thrown into the broadest relief against the black background, and a distinctness of outline is achieved that would be impossible under ordinary conditions.

At the other end of the hall is a cell, indicated by an ordinary door and an extraordinary window, glazed in panes of a lurid hue, which gives the finishing touch to the Rembrandtesque character of the picture. The compartment is devoted to the purpose of changing the film from the dark box to the kinetographic camera, being provided with a special track, running from the mysterious recesses at the back of the stage to its own special precincts, where fresh films are substituted for the ones already employed. The processes of development, etc., are performed in the main photographic building.

The *dramatis personæ* of this stage are recruited from every characteristic section of social, artistic, and industrial life, and from many a phase of animal existence. One day chronicled the engagement of a troupe of trained bears and their Hungarian leaders. The bears were divided between surly discontent and a comfortable desire to follow the bent of their own inclinations. It was only after much persuasion that they could be induced to subserve the interests of science. One furry monster waddled up a telegraph-pole, to the soliloquy of his own indignant growls; another settled himself comfortably in a deep arm-chair, with the air of a postgraduate in social science; a third rose solemnly on his hind legs and described the measures of some dance, to the weird strains of his keeper's music. Another licked his master's swarthy face, another accepted his keeper's challenge, and engaged with him in a wrestling-match, struggling, hugging, and rolling on the ground.

Of human subjects we have a superfluity, although the utmost discrimination is essential in the selection of themes. The records embrace pugilistic encounters, trapeze and cane exercises, dancing, wrestling, fencing, singing, the playing of instruments, speech-making, the motions involved in the different crafts, horse-shoeing, equestrianism, gardening, and many others.

We have yet to speak of the microscopic subjects, a class of especial interest, as lying outside of the unaided vision of man. In the treatment of these infinitesimal types, much



"THE BARBER SHOP."



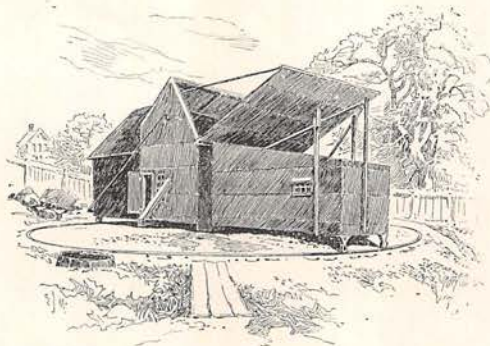
difficulty was experienced in obtaining a perfect adjustment so as to reproduce the breathing of insects, the circulation of blood in a frog's leg, and other similar processes of nature. The enlargement of animalculæ in a drop of stagnant water proved a most exacting task, but by the aid of a powerful lime-light, concentrated on the water, by the interposition of alum cells for the interception of most of the heat rays, and by the use of a quick shutter and kindred contrivances, the obstacles were overcome, and the final results were such as fully to compensate for the expenditure of time and trouble. We will suppose that the operator has at last been successful in imprisoning the tricky water-goblins on the sensitive film, in developing the positive strip, and placing it in the projector. A series of inch-large shapes then springs into view, magnified stereoptically to nearly three feet each, gruesome beyond power of expression, and exhibiting an indescribable celerity and rage. Monsters close upon one another in a blind and indiscriminate attack, limbs are dismembered, gory globules are tapped, whole battalions disappear from view. Before the ruthless completeness of these martial tactics the Kilkenny cats fade into insignificance. A curious feature of the performance is the passing of these creatures in and out of focus, appearing sometimes as huge and distorted shadows, then springing into the reality of their own size and proportions.

Hitherto we have limited ourselves to the

delineation of detached subjects, but we shall now touch very briefly upon one of our most ambitious schemes, of which these scattered impersonations are but the heralds. Preparations have long been on foot to extend the number of the actors and to increase the stage facilities, with a view to the presentation of an entire play, set in its appropriate frame.

This line of thought may be indefinitely pursued, with application to any given phase of outdoor or indoor life which it is desired to reproduce. Our methods point to ultimate success, and every day adds to the security and the celerity of the undertaking. No scene, however animated and extensive, but will eventually be within reproductive power. Martial evolutions, naval exercises, processions, and countless kindred exhibitions will be recorded for the leisurely gratification of those who are debarred from attendance, or who desire to recall them. The invalid, the isolated country recluse, and the harassed business man can indulge in needed recreation, without undue expenditure, without fear of weather, and without the sacrifice of health or important engagements. Not only our own resources but those of the entire world will be at our command. The advantages to students and historians will be immeasurable. Instead of dry and misleading accounts, tinged with the exaggerations of the chroniclers' minds, our archives will be enriched by the vitalized pictures of great national scenes, instinct with all the glowing personalities which characterized them.

*Antonia and W. K. L. Dickson.*



EXTERIOR OF EDISON'S KINETOGRAPHIC THEATER, ORANGE, N. J.