SCIENCE IN TOYS

VIII.

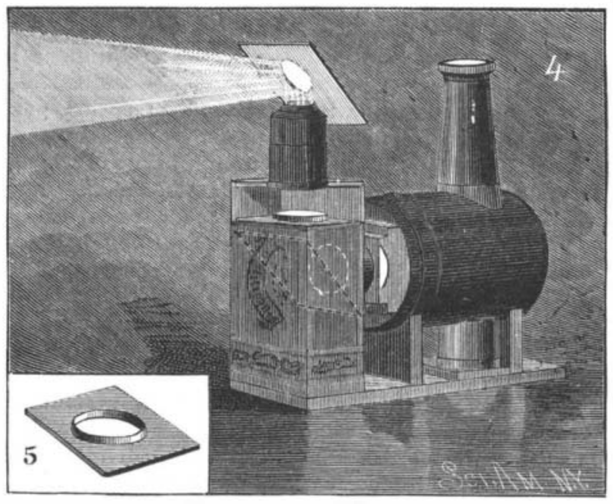
THE SCIENTIFIC USE OF THE TOY MAGIC LANTERN.

A toy magic lantern is generally considered as worthless as any piece of apparatus one can own. Usually, in these instruments, the source of light is unsatisfactory, the light is wasted, and the little light finally rendered available is passed through imperfect lenses, yielding results which are anything but pleasing. Generally, toy lanterns have been made without condensers, and almost without exception they are found to be of an odd size, which will not receive an ordinary lantern slide, so that the user must remain content with the daubs usually accompanying such instruments. Recently, however, some improvement seems to have been made in toy lanterns. The writer, in looking about for a toy lantern suitable for this series of experiments, came accidentally upon a type of lantern which in cheapness, compactness, generally good design, finish, and efficiency excels all others with which he is acquainted. Still it has a serious defect, that is, considerable spherical aberration. This can be easily remedied by replacing the front lens of the objective —which is a double convex of four inch focus—with a meniscus (periscopic) spectacle lens of the same focus.

This lantern is shown in side elevation in Figs. 1 and 2 respectively. It is made of several sizes, but the size which costs $3.75 or $4 is as small as can be used to advantage in the experiments illustrated in the annexed engravings.

The lantern is 12½ inches high, including chimney; the cylindrical body is 5 inches in diameter and 6½ inches long. The back of the body is closed by a spun, concave reflector. The condenser is a double convex introduced is one-sixteenth of an inch too narrow for average slides, but, if desirable, a clever tinsmith can correct this in a very short time.

It is not intended to treat of the projection of pictures with this instrument; but it may be said, in passing, that the lantern, when altered as suggested, pro-



VERTICAL ATTACHMENT.

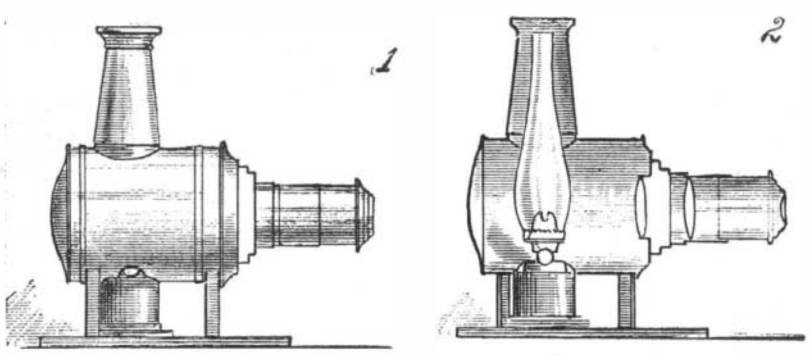
jects a very good picture, 6 feet in diameter. A little camphor added to the kerosene increases the light perceptibly, and a clean chimney and clean lenses go a long way in the utilization of the light.

The number of interesting experiments which may be successfully performed with this little lantern is surprising. Certainly a long evening of rational and

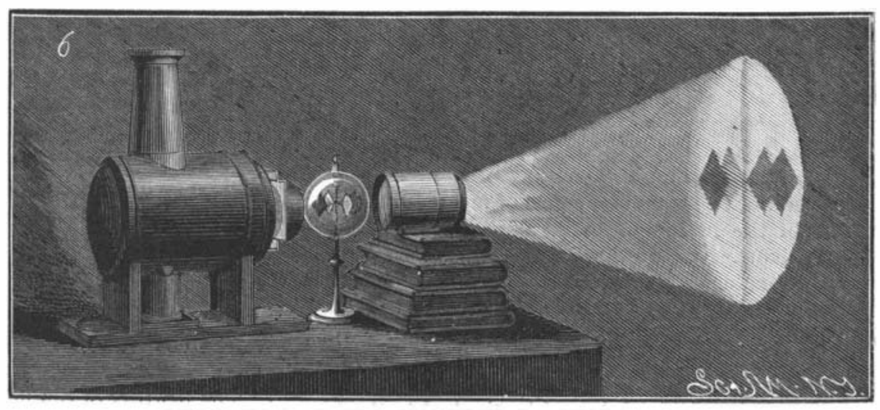
The slide thus prepared is placed in the lantern, and the point of a knife blade is introduced between the upper corners of the glass plates. Upon the smallest separation of the plates, arborescent figures will appear on the screen, which will grow as the plates are further separated, appearing as shown in Fig. 3 like a growth of cactus or fern. On removing the knife blade, the plates will be drawn together by the rubber bands, and the figures will disappear. The experiment may be repeated again and again with the same charge of vaseline, but it will, in time, become so thin as to require renewal.

In Fig. 4 is shown an attachment for converting the instrument into a vertical lantern. The objective is removed from the lantern, and a cigar box of suitable height is arranged with its open side next the front of the lantern. In the box opposite the condenser of the lantern is arranged a piece of ordinary looking glass at an angle of 45°. In the top of the box is made a hole for receiving the objective. In the box, an inch and a half from its upper end, is arranged a horizontal transparent glass plate, and above the glass plate the box is cut away diagonally across the corners, leaving only material enough in the end to hold the objective. A second mirror, arranged parallel with the first, is supported over the end of the objective, and serves to throw the image on the wall. If the experimenter will be satisfied with images on the ceiling, the second mirror may be dispensed with.

The tank shown in Fig. 5 is designed to hold various liquids used in experiments in the vertical lantern. It consists of a plate of glass to which is secured a ring of tin, by means of a cement composed of pitch, gutta percha, and shellac, equal parts, melted together. In



TOY MAGIC LANTERN.



ARRANGEMENT FOR PROJECTING APPARATUS.

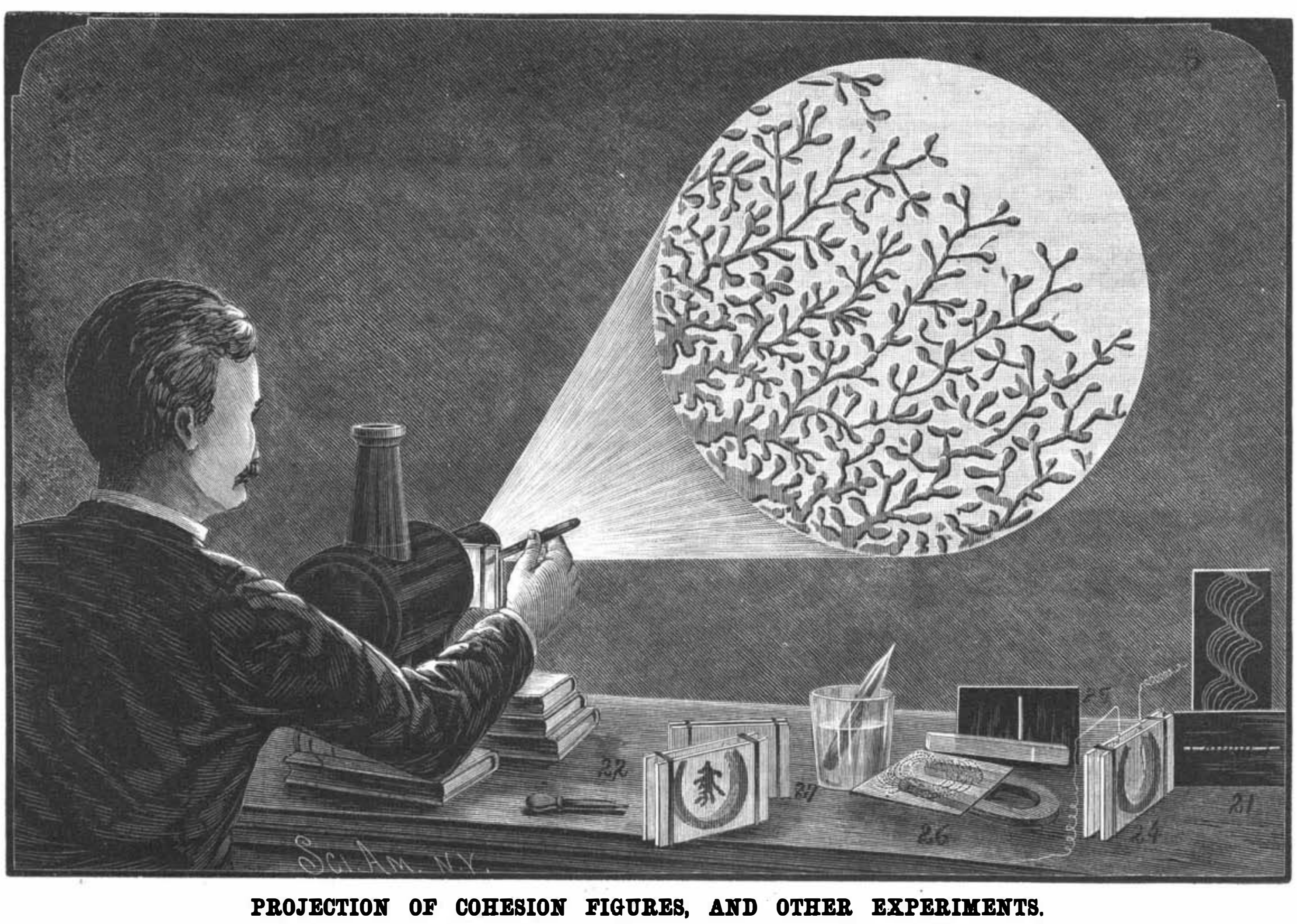
lens, 2⅜ inches in diameter and 4 inch focus. The rear lens of the objective is a double convex, 2⅜ inches diameter and 5½ inch focus, and the front lens is, as already stated, 4 inch focus and its diameter is 1¼ inches. The optical combination is not the best that can be devised, but it answers a very good purpose.

The lamp has a kerosene burner of approved type, and is provided with a tall chimney, which insures perfect combustion and a white light. The reservoir of the lamp, as well as the objective tube and lantern chimney, are nickel plated. The space in which slides are

instructive amusement may be gotten out of the lantern with little expense beyond the cost of the instrument itself, and with very little trouble.

The production of cohesion figures on the screen is a simple and interesting experiment. Between two glass plates of a width suitable for the lantern is placed a small amount of vaseline, either plain or colored with alkanine or aniline. The plates are pressed together until all of the air is expelled, and a thin film of vaseline remains. The glasses are then clamped together by means of two stout rubber bands.

this tank may be placed clean water. A cambric needle, carefully laid on its side on the surface of the water, will float, and the needle and depression in the water formed by the needle will show plainly on the screen. If the needle be magnetized, it may of course be attracted and repelled by a magnet. A few bits of gum camphor thrown on clean water will move about in a curious way. A few drops of a solution camphor in benzole, dropped on the water, yield very interesting results. Curious effects are produced by a drop of some of the essential oils. The oils



PROJECTION OF COHESION FIGURES, AND OTHER EXPERIMENTS.

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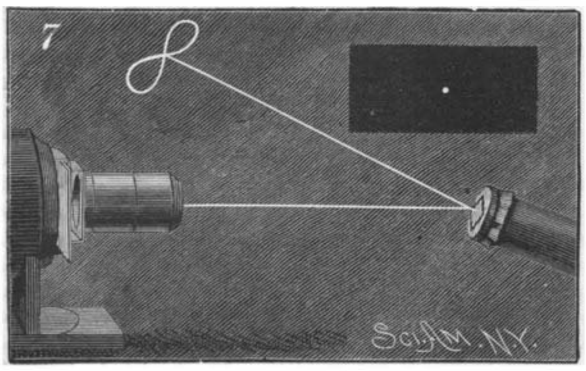
of cinnamon, coriander, and lavender, are examples. In Fig. 6 is shown the method of projecting a piece of apparatus; in the present case, a radiometer. The objective is removed from the lantern, and supported a short distance in front of it, and the apparatus is placed between the lantern and objective.

In the case of the radiometer the heat of the lantern causes radiometer to revolve, so that it is seen in motion on the screen.

In Fig. 7 is shown a simple device, known as the opeidoscope. It consists of a short paper tube, having a thin piece of rubber stretched over it and tied. A

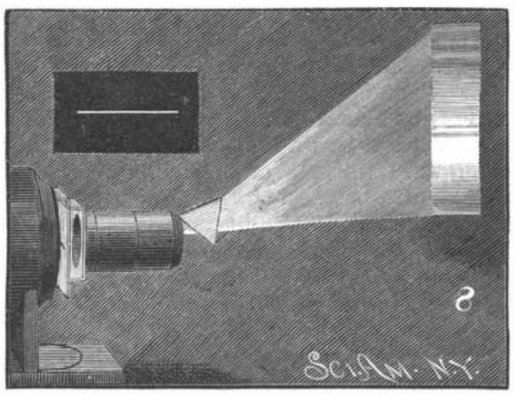


THE OPEIDOSCOPE.

small piece of mirror is cemented to the center of the rubber.

The perforated card shown in the corner of the engraving is inserted in the lantern, and a pencil of light is allowed to fall on the mirror, and when different notes are sung into the open end of the paper tube, the reflected pencil of light will form intricate figures on the wall.

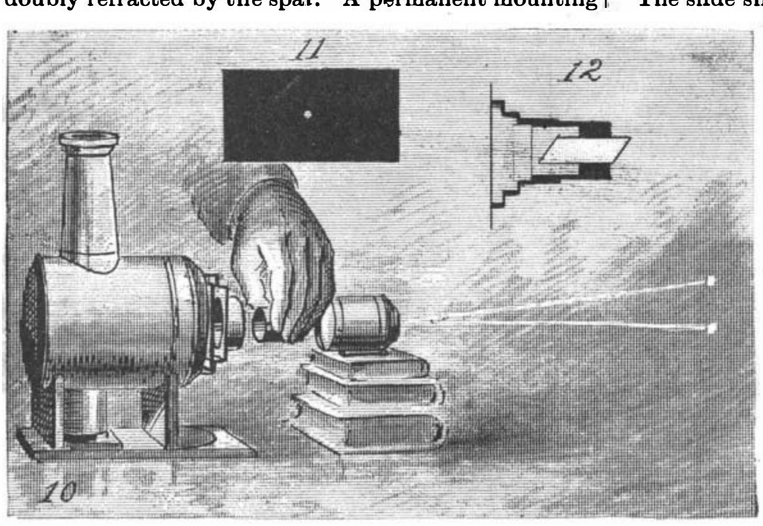
In Fig. 8 is shown the method of projecting the spectrum. The card shown above the lantern has a central longitudinal slit about three-sixteenths inch wide. This card is inserted in the lantern, and the



PROJECTING THE SPECTRUM.

slit is focused on the screen. An ordinary glass prism is now placed in front of the objective, and turned until the best effects are secured.

In Fig. 10 is shown an experiment in double refraction. The perforated card shown in Fig. 11 is inserted in the lantern, and the objective is arranged as described in connection with Fig. 6. The aperture of the card is focused on the screen, and a crystal of Iceland spar is placed between the lantern and the objective. Two images of the aperture of the card will appear on the screen, showing that the ray has been divided or doubly refracted by the spar. A permanent mounting

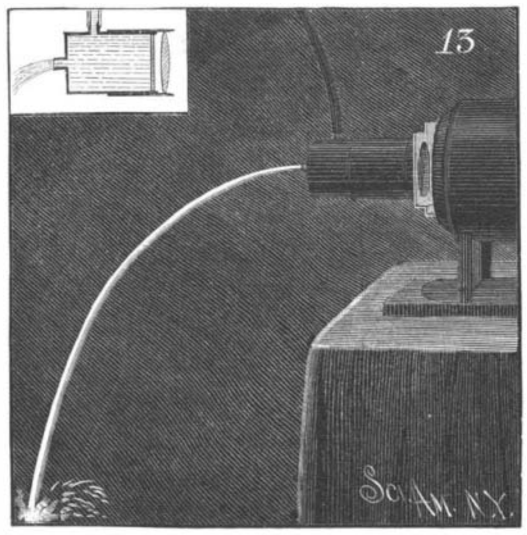


DOUBLE REFRACTION.

for the spar may be arranged as shown in Fig. 12, the spar being mounted in a cork fitted to a tube adapted to the lantern front.

In Fig. 13 is shown a device for producing a luminous fountain. A tube is fitted to the rear half of the objective tube and closed at the rear end by a glass disk, cemented in by means of the cement above described. The front end of the tube is closed, with the exception of an orifice three-eighths inch in diameter, in which is inserted a smooth tube about one-half inch long. A nipple projects from one side of the fountain tube, for receiving the rubber supply pipe, which may either be connected with the house water supply or it may be used as a siphon, taking water from an elevated pail or tank. Only a small head is necessary to secure the desired results. The stream will be illuminated throughout its entire length, if a smooth flow of water is secured, and it may be tinted by inserting colored plates of glass in the slide receiver.

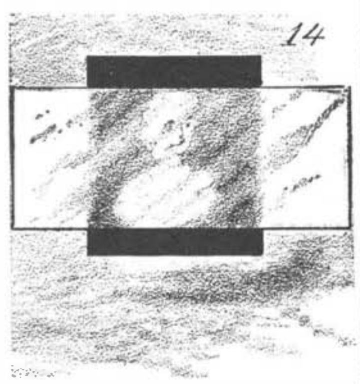
In Fig. 14 is shown some curious effects of refraction. A portrait is placed in the lantern, and in front of it is



LUMINOUS FOUNTAIN.

placed a piece of wrinkled window glass, which is slowly moved back and forth, the curved surfaces of the glass producing distortions of the face which are sometimes ludicrous.

In Fig. 15 is shown a kaleidotrope, which illustrates persistence of vision. A card having several circles of small perforations, say one-eighth inch, is cemented at its center to one end of a short spiral spring, the opposite end of the spring being cemented to a plate of glass which fits in the lantern. By placing this slide in the lantern and striking the card so as to cause it to vibrate in different directions, a great variety of curves will be described on the screen by the light spots, and owing to the persistence of vision, these curves will be seen as continuous lines.



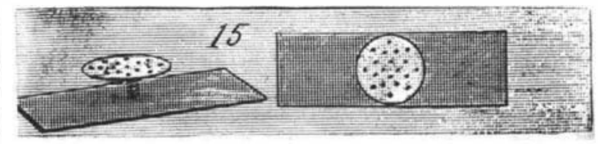
REFRACTION.

A disk of perforated cardboard or tin pivoted centrally to a plate of the same material, as shown in Fig. 16, exhibits a certain phase of interference when it is placed in the lantern and the disk is revolved slowly. This is a very simple device, but it is well worth the trouble of making.

Fig. 17 shows a cardboard disk provided with radial slots, and pivoted on the end of a handle. It is designed to be whirled in front of the lantern tube, to interrupt the light beam, to show the effects of intermittent light on moving objects.

The slide shown in Fig. 18 is designed to show the tiring of the eye, by the observation of a semicircular light spot on the screen, for a considerable length of time, then quickly providing a similar spot, having the same illumination, for comparison.

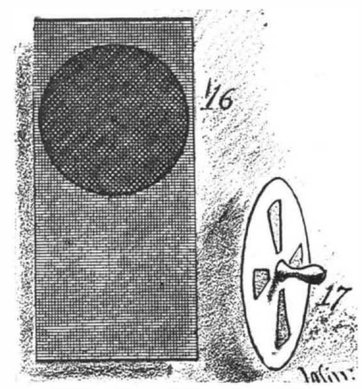
This slide is made by cutting in a slip of pasteboard two semicircular holes, with a bar between, then arranging a card to cover the lower semicircular hole, while the upper one is open. The card is attached to one end of an elastic band, the other end of the band being fastened to the pasteboard slip. The card is provided with a string, by which it may be held in place over the lower aperture of the slip. After the slide is exposed in this condition for a few seconds, and the eye becomes wearied by viewing the white spot on the screen, the card is released, and the rubber withdraws it from the lower semicircular aperture, when both halves of the circle will appear, and although they are equally illuminated, the half longest on the screen will appear much darker than the other. The slide shown in Figs. 19 and 20 is designed to illustrate the wave theory of light. The plate, Fig. 20, which fits the lantern, is made of a glass photographic negative plate, exposed and developed to render it opaque. A number of parallel scratches are formed one-eighth inch apart in the film by means of a large needle. The slide, Fig. 19, should be of the same width as the plate, Fig. 20, but three or four times as long. Upon this slide, which is also a piece of negative glass, is scratched a sinuous line, covering about one-third the width of the plate. This line is easily made by the aid of a sheet metal pattern laid out by means of compasses. By placing the plate with the parallel scratches in the lantern, and moving the slide over it, a series of dots, representing ether particles, will be seen to move up and down on the screen without advancing, but the waves formed by the dots move on.



KALEIDOTROPE.

In Fig. 21 is shown a device for illustrating the compression and rarefaction of air in sound waves. This slide differs from the other in having a single straight slit on one glass, and on the other glass a series of sinuous slits gradually advancing in position in the series. By moving the long plate over the short one, series of dots representing air particles will be seen to advance toward and recede from each other.

In Fig. 22 is shown a vertical tank which is thin enough to enter in the place of a slide in the lantern. This tank is formed of two plates of glass and a segment of a fruit jar packing ring. If one ring is not thick enough, two may be used. The rings are coated on opposite sides with shellac varnish, and immediately placed in position between the glass, and the glasses are bound together by means of stout thread or, better, fine wire. The tank may be used immediately.

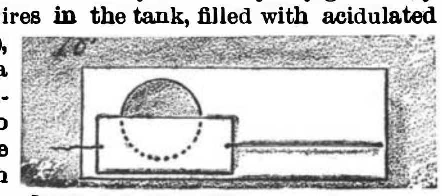


PERFORATED TIN AND APERTURED DISK.

The following are, in brief, some of the experiments to be tried with this tank.

Place in it clean water, and while it is in the lantern drop in a small quantity of ink.

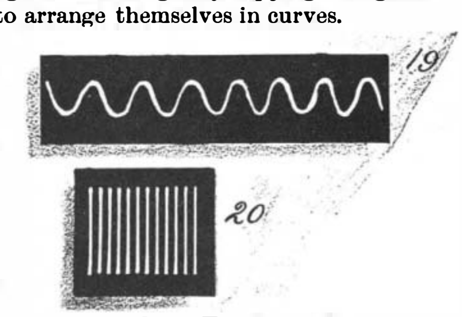
Try alcohol or glycerine in water, in the same way. Put in a weak solution of nitrate of silver, add a drop of solution of common salt. To a weak solution of blue litmus add a little vinegar or other acid. The solution turns red; add a little ammonia, and the solution again becomes blue. These are striking experiments, and there are many others equally good. By placing two wires in the tank, filled with acidulated water (Fig. 24), and attaching a battery of sufficient power to the wires, the decomposition of water may be shown.


SLIDE SHOWING THE TIRING OF THE EYE.

In Fig. 25 is shown a device for exhibiting refraction. A card, having a slit one-sixteenth of an inch wide and about two inches long, is placed in the lantern, and in front of it is held a strip of plate glass. So long as the glass is parallel with the card, no effect is produced; but when the glass is held at an angle with the face of the card, the line of light passing through the slit is bent aside or refracted.

Magnetic curves (Fig. 26) are shown on the screen by placing the magnet on the vertical attachment, placing on the magnet a glass plate, sprinkling on the glass a few iron filings, and then gently tapping the glass to cause them to arrange themselves in curves.

The chemical thermometer (Fig. 27) is projected after warming it until it is quite blue, then dipping it into a glass of cold water in the field of the lantern. The changes from blue to pink are very pretty. The change begins at the outside.



LIGHT-WAVE SLIDE.

By coating glasses with solutions of various salts, crystallization may be seen in progress on the screen.

By means of a simple magnetic needle mounted on a point cemented to a glass plate, and used in the vertical attachment, various experiments in magnetism may be performed.

No attempt has been made to treat the subject exhaustively, but enough has been suggested to show that a considerable amount of experimentation may be done with a cheap lantern and easily made accessories.

G. M. H.

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