

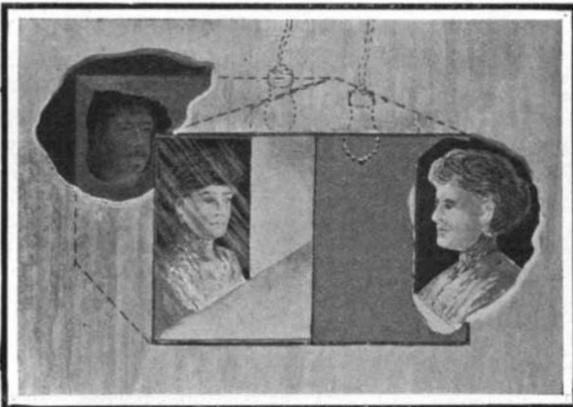
peals to the fancy of the maker. Put a blank on the end of a hardwood block, such as maple, and with a small punch, any shape, punch out the outlines of the design as closely as possible. After this the blank is turned over and laid on a piece of soft iron, and with a small prick punch a number of indentations are made in it between the outlines of the design.

After the blanks have thus been prepared, solder strips of metal on the inside, for the purpose of holding the glass, also to make the blanks stiff (Fig. 3). Now solder the blanks together. Small bows of lead ribbon may be made and fastened at the corners, giving the impression that the several blanks are tied together. The shade is now ready to be painted. Use any kind of paint that will dry flat, such as ivory black. When dry, place between the glass and the frame a color screen of colored gelatin or celluloid. Different colors may be pasted on the glass, side by side, so as to bring out the different colors the design is supposed to represent. For instance, if the design should be a bunch of cherries on a twig, red may be used for the cherries, brown for the stem, and green for the leaves.

When the glass is finally put in place, the pieces of metal soldered on the inside of the shade are now turned over, so as to hold the glass in place. Care should be taken that the glass does not fit too tightly. Always give it more or less room to allow for thermal expansion. A string of beads may be fastened to the bottom or lower edge of the shade.

The shade may be made of paper, in which case two blanks are used. These are fastened and perforated at the same time with a large needle over a small cushion of sand or emery. The color screen is then inserted between the blanks, and the latter are bound together with ribbons. Another pretty effect may be

may be made to appear or disappear as the operator desires, by the manipulation of the switch. An interesting adaptation of this box is to provide an opening in the side of the box, as well as one in the rear opposite the front opening, so as to permit two persons to place their heads in the compartments. These persons will be hidden behind a curtain, as indicated



ON TOUCHING THE BUTTON ONE FACE MERGES INTO THE OTHER.

in one of the illustrations. Now, on operating the switch, first one face and then the other may be made instantly to appear in the box. If a dimmer is used, which will gradually shut off the light of one lamp while turning on the light in the other, one face may be made to fade and merge into the other. This illusion box should make an interesting feature of the Christmas entertainment.

A TRICK WITH TOURMALINE.

BY PROF. GUSTAVE MICHAUD, COSTA RICA STATE COLLEGE.

The little apparatus here described allows one to see easily any object in spite of an obstacle which will prove insuperable to all eyes but yours. The principle which underlies the experiment is not widely known among persons who have not made a study of optics, and the performance always causes considerable curiosity, even after the mystery has been duly explained.

You hold a plate of transparent, colorless glass in your hand, and ask the company whether anyone feels sure he can always read plain writing or print directly under the glass, within a reasonable distance from the eye and with plenty of light falling upon it. Upon receiving an affirmative answer, you bring a table near the window. The plate of glass, with some printed matter under it, is laid flat on the table, close to the window. A few books are piled on the other end of the table. You rest your chin upon them, and then move the plate of glass until you can see the luminous sky reflected on the glass under an angle

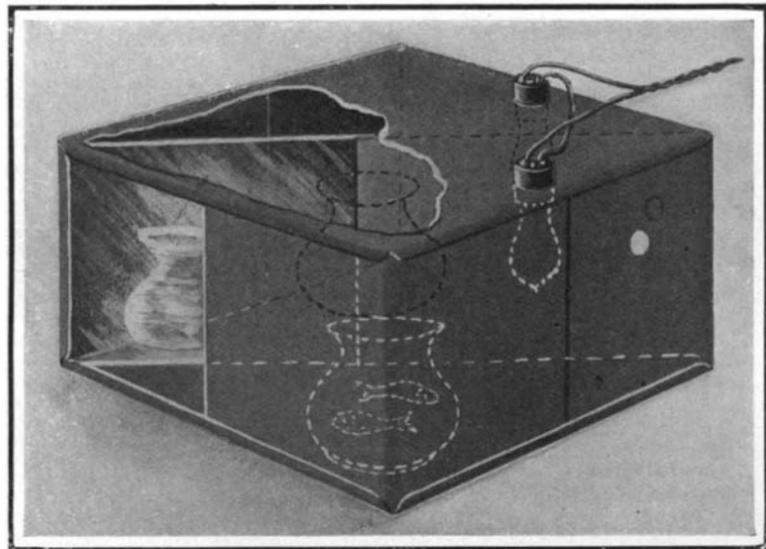
the glass decreases the sensibility of the retina, closes partially the pupil, and prevents the seeing of anything which is much less luminous than the sky.

You draw from your pocket what seems to be a small disk of common green glass framed in a piece of cardboard. You pass it along. It is neither a prism nor a lens, and changes nothing in the position or shape of objects, yet through it you read aloud at once the invisible script under the glass. Your neighbor confidently takes your place with the green glass in his hand. He occupies exactly the position you occupied; he holds the glass exactly as you did, only to find matters a little worse than before. The bright sky on the glass has become greenish, but there is not the slightest indication of anything lying under the glass. The game may last as long as you wish. Anybody in the company may change the script for another. You can always read it, nobody else can. Finally, you kindly allow everyone to be as clever as you are, and from that very moment, although no perceptible change has occurred anywhere, everybody can read through the green glass, but only through it. The bright sky has apparently vanished; the script is distinctly seen and easily read.

The key to the mystery is the peculiar nature of the intense light sent by the surface of the glass. What seems to be a single plate of glass is a bundle of three plates, which have been framed together with some *passe-partout* binding, care being taken to keep them apart with strips of the same binding stuck on the margins of the plates. Light reflected upon such a bundle of plates is nearly entirely polarized, whenever the rays make with the plates an angle which is not very far from 34 deg. Our eye makes no difference between polarized and ordinary light, but a slice of tourmaline, which is transparent for ordinary light, is opaque for polarized light if the principal axis of the tourmaline be parallel to the plane of polarization. During the experiment, the eye receives both the dazzling light reflected on the plates and the comparatively faint light sent by the script. The tourmaline is opaque for the first-named source of light, and transparent for the second. It acts as a filter, which allows only the passing of such light as is helpful in reading the script.

But to deprive the tourmaline of its opacity for polarized light, it suffices to place its principal axis perpendicular to the plane of polarization, that is, at right angles with its previous position. This is easily done, and without running the risk of being detected, by a twist of the fingers laid on the cork mounting of the tourmaline. Another quarter of a revolution will restore to the tourmaline its filtering properties. The line cut illustrates the mounting of the tourmaline. P is a holder of black pasteboard, C a cork disk cut out of a common stopper, T a slice of tourmaline, and B black paper which gives the tourmaline the appearance of a disk.

During the experiment, the main light should not come from more than one window. If this precaution be neglected, the relative amount of diffused light sent by the script is increased, and some black and white may be perceived under the glass. Slices of tourmaline, cut parallel to the principal axis of the crystal, are sold at a moderate price by dealers in laboratory apparatus. They are used mostly by mineralogists for the study of the optical properties of crystals.



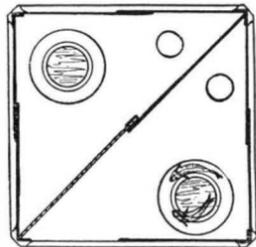
THE GOLD FISH APPEAR AND DISAPPEAR AT THE TOUCH OF A SWITCH.

obtained by using two blanks of white Bristol board, without any perforation, and instead of the color screen, place between the sheets some pressed flowers, leaves, grasses, or the like.

The Christmas Entertainment.

A PUZZLING DISPLAY BOX.
BY FRANK C. PERKINS.

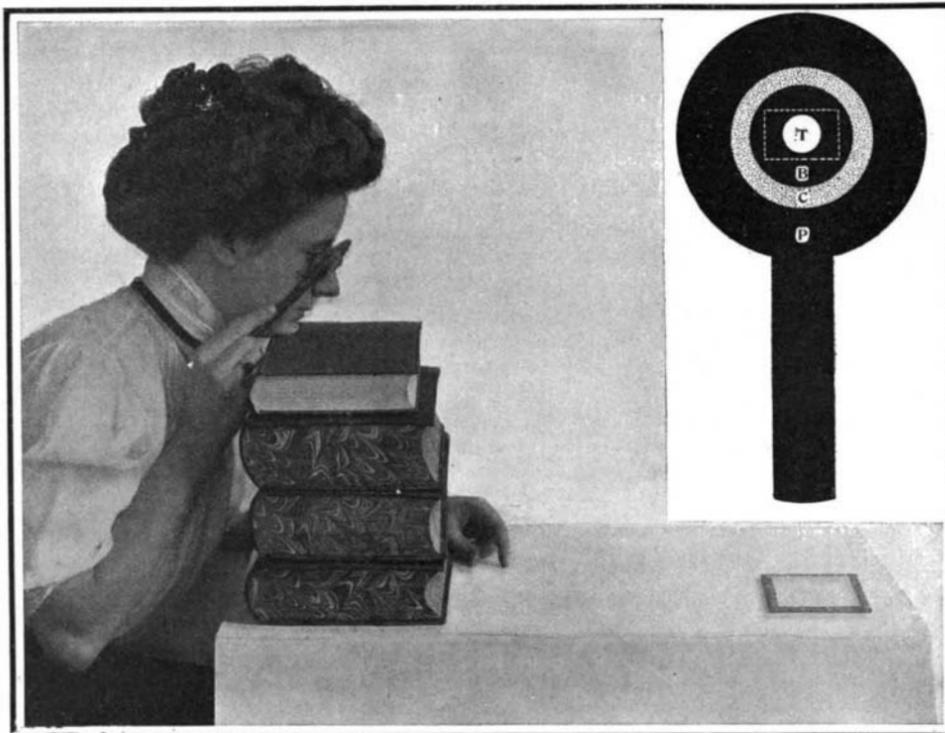
An interesting electrical illusion box has recently been devised, which is well within the ability of a handy man to construct. It consists of a perfectly square box of any material, such as wood or tinplate soldered together. The box is divided into two compartments by a diagonal partition consisting of two sections of equal size, one of the sections being a glass plate. Immediately in front of the glass section there is an opening in the box, through which observers can view the illusions. The whole interior of the box except the glass plate is painted a dead black. The illusion is produced by placing two objects in the two compartments. One of these objects may be a globe containing gold fishes, and the other



SECTIONAL PLAN VIEW OF THE ILLUSION BOX.

a globe of identically the same shape, but empty. The compartments are lighted by two electric lamps symmetrically placed, one in each compartment, but out of range of the opening in the front of the box. When the lamp in the forward compartment is lighted, the object therein will be seen by reflection in the glass. When the switch is thrown to put out the light in the forward compartment, and to light the lamp in the rear compartment, the other object only is seen through the glass partition. In this way the fishes in the globe

receiving an affirmative answer, you bring a table near the window. The plate of glass, with some printed matter under it, is laid flat on the table, close to the window. A few books are piled on the other end of the table. You rest your chin upon them, and then move the plate of glass until you can see the luminous sky reflected on the glass under an angle somewhat smaller than 45 deg. (34 deg. will give the best results, but there is no need of accuracy). In such circumstances you will find yourself unable to see anything under the glass. The assistants may try, one after the other, to take your place and read the script; their attempts are vain. On the plate they see the bright sky. Under it they see nothing, not even the shape or color of the sheet of paper. The intense light reflected on the surface of



The invisible printing is read easily through what appears to be common green glass.

A TRICK WITH TOURMALINE.